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International Marine Engineering

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15=YARD DIPPER DREDGE.

The dipper dredge has several advantages over all other types of dredges for certain work, and on this account it has been highly developed in North America. In the first place, no mooring lines are required, so that where the dredge is reclaiming swamp land it is not necessary to have men out on the bank, and where digging a ship channel it is possible for the dredge to operate continuously, offering the least obstruction to navigation. The reason for this is that the dredge operates on what are known as "spuds." These are heavy posts, which, if the dredge is large, are usually built up of several timbers, and so arranged with respect to the hull that they may be forced down to the point of refusal in the material in the bottom of the channel, thus forcing upward the bow end of the dredge and making of it a stable platform, enabling the dipper to be forced into the material to be excavated with much greater effect than where a dredge is held to its work by mooring lines only.

The second advantage of the dipper dredge is that it is possible for the operator to exercise the greatest control at the contact of the digging part of the machine with the material to be excavated. It is thus possible to bring up large masses of rock, sunken timber, etc., which could not be done with any other dredge. It enables the operator to feel around on the bottom and attack large boulders in such a way as to bring them up successfully. In work of this nature the dipper dredge easily outdistances an elevator or clam-shell dredge, where in easier digging the advantage is not so marked. The dipper dredge is the logical complement of the drill boat.

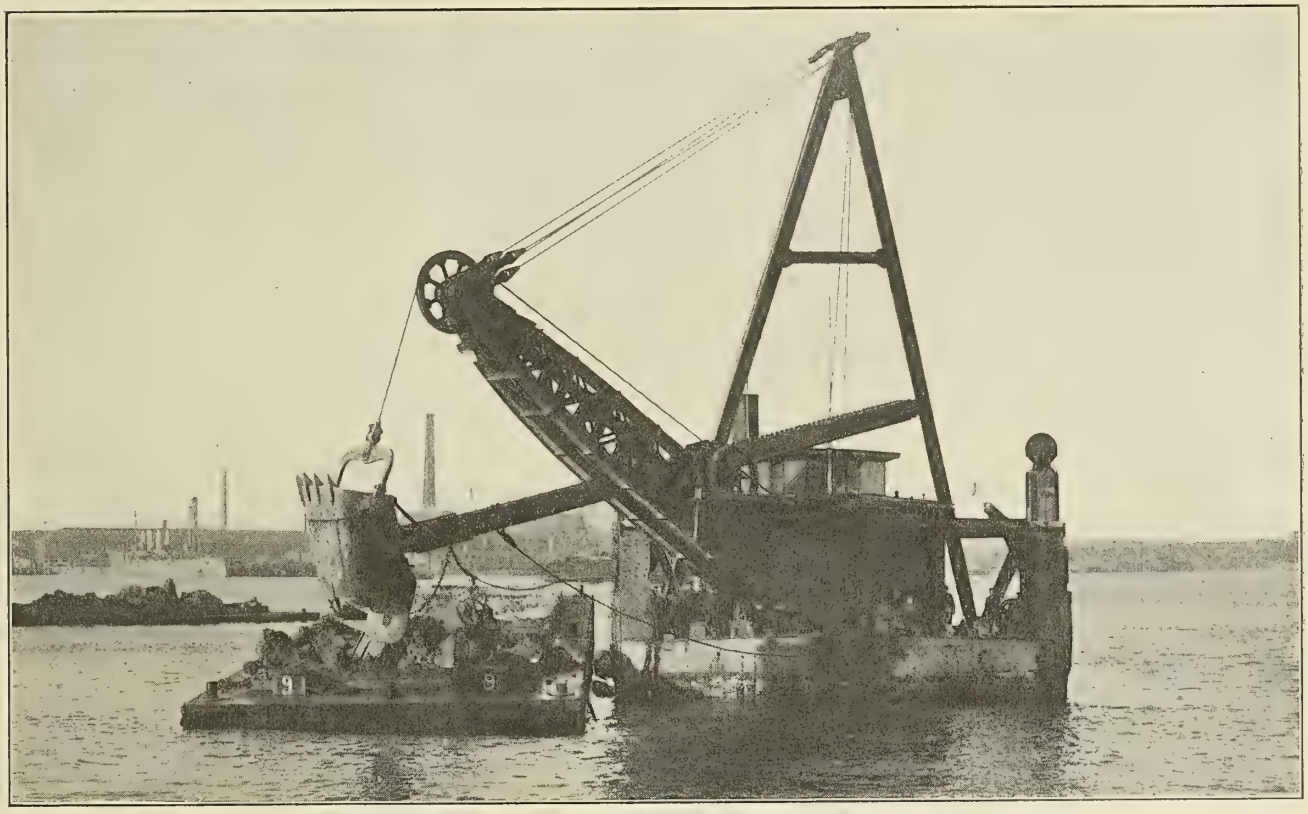


FIG. 1.—THE TOLEDO, SAID TO BE THE LARGEST DIPPER DREDGE IN EXISTENCE.

The third advantage is the fact that it requires a very much smaller first cost to obtain a dredge which is able to apply effective digging force to the material to be excavated.

The largest dipper dredge in existence is the dredge *Toledo*, built for work in Broad Sound in connection with the improvement of Boston harbor. It is at present digging fairly good material, but will soon return to the work in Broad Sound, which is quite hard and must be dug in a seaway. The dredge is capable of digging to a depth of 55 feet below the water surface.

There are other dredges which handle a 15-yard dipper, but they are what are known as "combination dredges," which can

be rigged up to use either a clam shell or a dipper. In either case the swinging is done in the manner used on all clam-shell dredges, which results in a very slow swinging movement and very little control over it. These dredges also do not use spuds, and therefore are unable to exert so much power in the excavation of the material. The machinery and power plant on these other dredges, therefore, do not correspond in any way with the similar parts on the *Toledo*. The length of the hull is 135 feet, breadth 44 feet, average depth 13 feet 6 inches. All of the engines are in the hold with the exception of two small engines on deck for operating the winches for warping scows.

The hoisting engines are horizontal, twin-tandem, compound condensing, with Stevenson link valve motion. The valves on the high-pressure cylinders are piston valves, and those on the low are flat slide valves. These engines are compound geared to a large spur gear on either end of the hoisting shaft which carries the hoisting drum. This drum is grooved for 3-inch wire rope and is conical, giving the maximum digging power and slowest speed when the dipper is down and the angle between the dipper handle and the hoisting rope is small, and gradually increasing in speed and decreasing in power as the angle between the dipper handle and the hoisting rope becomes greater, allowing a more effective pull on this account. The drum is mounted loose on the shaft, and is driven by means of a very successful clutch arrangement. which has proved to be the only device which will take care of the enormous power of the engines. The clutch is operated by a steam cylinder.

The backing engines are horizontal, double-cylinder, single-expansion engines, geared directly to the gear on the backing shaft, which operates a cylindrical backing drum, grooved for wire rope and made to revolve with the gear by means of a clutch operated by a steam-thrust cylinder.

The swinging machinery consists of a horizontal, double-cylinder, single-expansion engine, compound geared to a large gear on the swinging shaft, which is fastened directly to the cylindrical swinging drum, to which drum the two swinging ropes are led in such a way that, by reversing the engine, the boom may be swung from side to side.

Each forward spud is raised or thrust downward by a horizontal, double-cylinder, single-expansion engine, compound geared to a large gear mounted on the spud drum shaft. The drum is cylindrical, grooved for wire rope, and is connected directly to the gear with a very effective brake apparatus, operated by a brake cylinder, which can produce and maintain a carefully graduated restraint on the motion of the backing drum, or hold it in one position. It has been found that the digging pull is so tremendous on this dredge that it is necessary to use spud pads on the bottom of the forward spuds. These pads are attached to the spud by a pin through the spud, allowing some motion to the pad independent of the spud. These pads are 6 to 8 feet across, and prevent the spud from sinking too far.

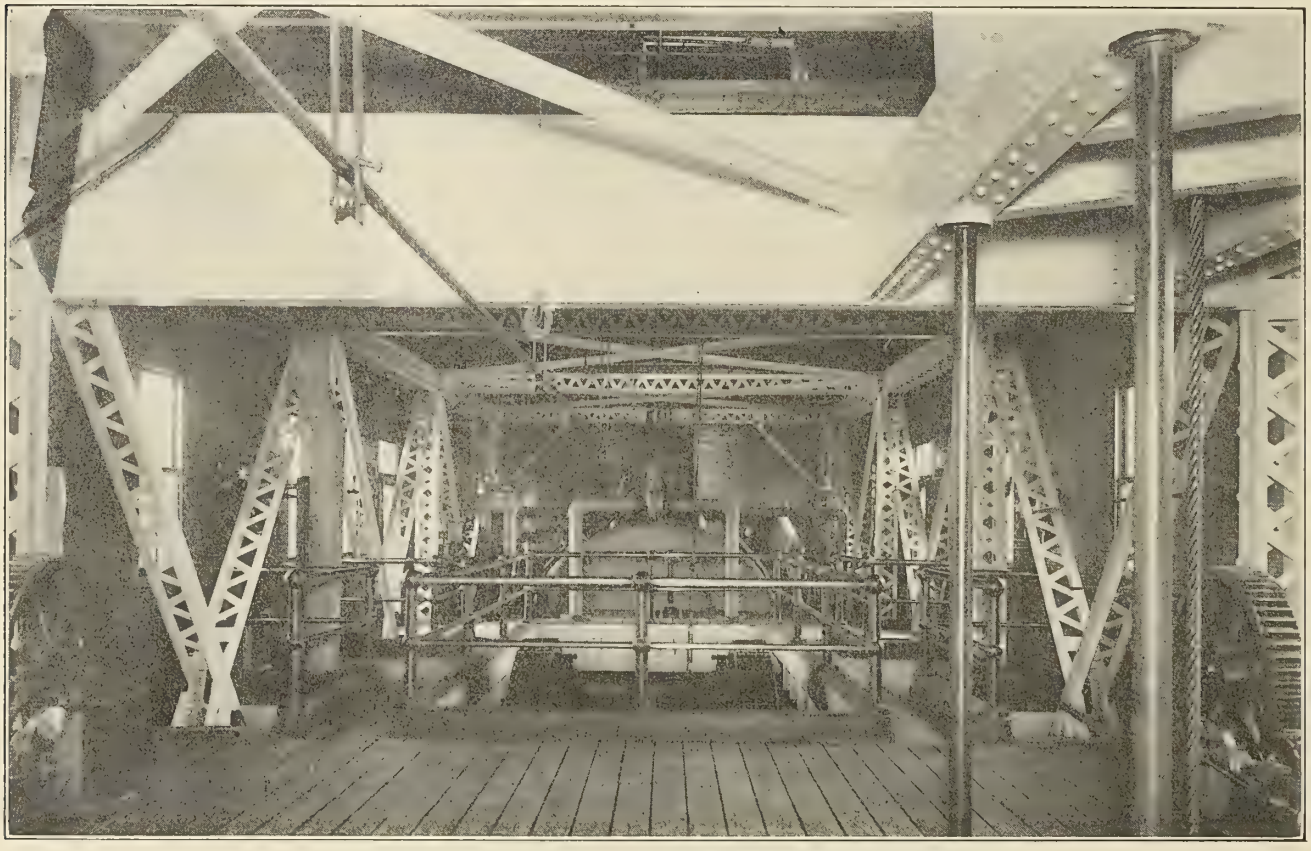


FIG. 2.—MAIN DECK OF THE TOLEDO, LOOKING AFT FROM THE OPERATING PLATFORM.

On a dredge of this size it has been found advisable to use two stern spuds instead of one, as is usually done. The reason for this is that the hull is so large and offers so much resistance to the waves, wind and current that it is found necessary, in moving ahead, to raise up one of the trailing stern spuds and drop it in a vertical position while the other trailing spud keeps the dredge lined up in the cut. The dredge, therefore, while moving ahead and dropping the forward spuds ready to excavate, is kept in line by the dipper and one stern spud. With only one stern spud a few moments would elapse with no anchor at the stern. The engine for operating each stern spud is a twin-cylinder, single-expansion, horizontal engine, compound geared to a wire rope drum, from which the wire rope leads to near the foot of the spud. The spud drops of its own weight and is raised by the cable. When the spud is down the engine is thrown out of gear.

The boom is stepped in a steel center bearing located on a

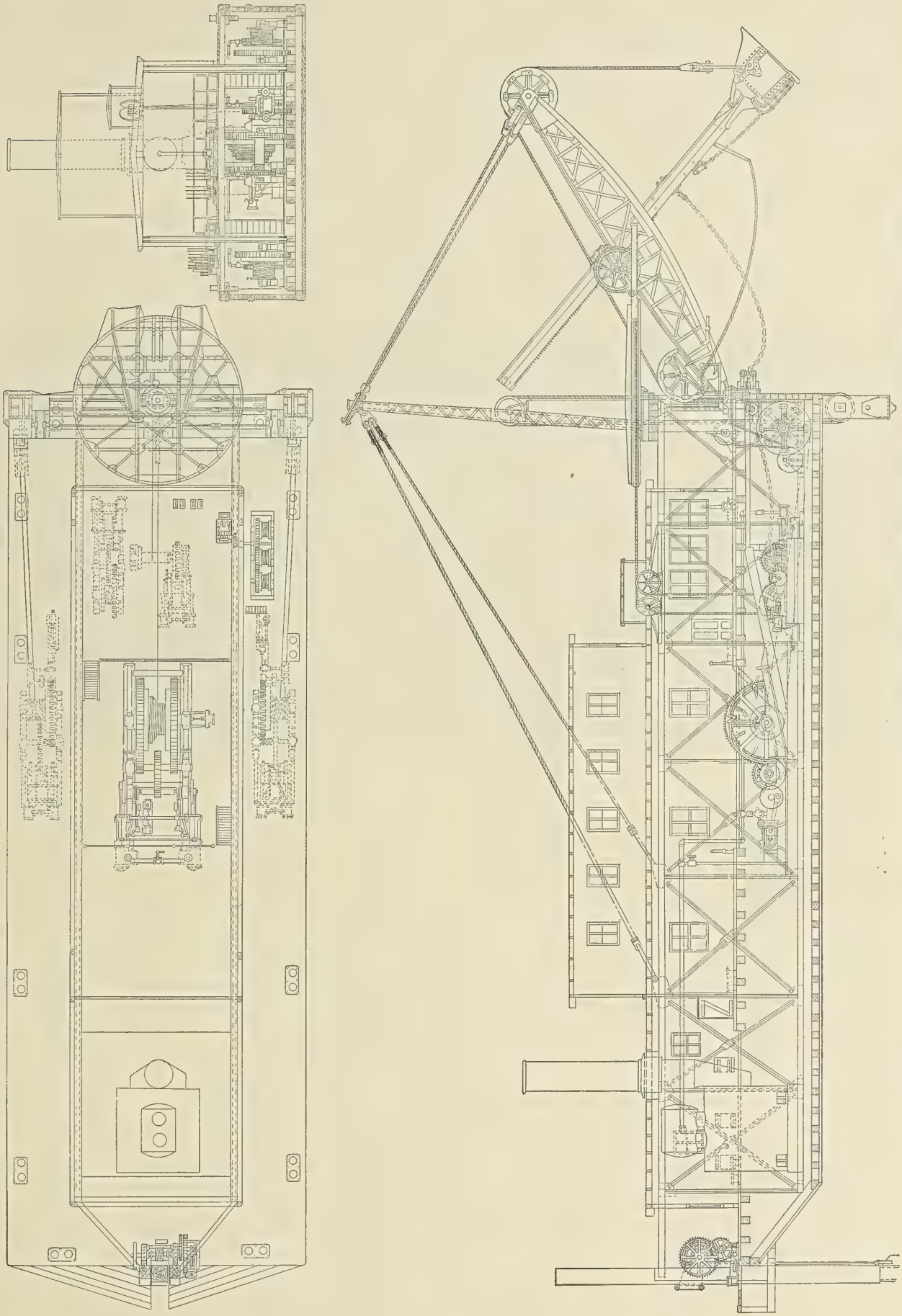


FIG. 3.—INBOARD PROFILE, DECK PLAN AND CROSS SECTION OF THE TOLEDO, SHOWING CONSTRUCTION OF HULL AND LOCATION OF DREDGING MACHINERY.

level with the main deck. The boom is entirely built up of structural steel, being shipped in two pieces for convenience. The swinging of the boom is effected by mounting the swinging circles on top of the steel truss, at such an elevation above the deck that by extending forward on both sides of the boom heavy structural arms, they take hold of the boom as near the central point as possible. The swinging ropes encircle the periphery of the swinging circle. From the circle they extend back to the vertical sheaves, which lead the rope down to the swinging drum located in the hold. An arrangement is made on the circle to take up any slackness of these ropes.

The dipper handle is of the usual construction with racks, which engage pinions on the shipper shaft on the boom, the revolutions of the shipper shaft being under control of the cranesman through the medium of two large brake wheels, carrying brake bands. The dipper has four teeth, and is of as heavy construction relatively as are the smaller dippers, enabling it to do extremely hard work. The dipper door latch is operated by means of a wire cable, which runs up the dipper arm and is fastened to the upper end of the arm. Where the cable passes through the boom it runs over a sheave on the boom and back to a sheave attached to a sliding cross-head; from there back to another sheave and thence to the top of the arm. The sliding cross-head is operated by a steam cylinder.

The A-frame legs are fastened to the deck by means of a universal joint. The legs are box girders, and the boom hangs from the A-frame collar by means of four cables. The A-frame has four back guys, distributing the digging strains through the hull, the strains in all being equalized at the A-frame head.

A dredge of this size requires very large scows, the one shown in the illustration having a capacity of 1,500 cubic yards.

The hull is of timber, but there are two steel trusses running the full length of the hull fore and aft with substantial cross trusses at the bow. These appear in the illustration.

Fig. 2 shows the main deck, looking aft from the operating platform. This view gives a good idea of the taste shown by the owners in fitting up the dredge. The quarters for the crew are on the upper deck, and consist of a large, well-lighted galley, forward of which are the sleeping rooms and bath.

The steam plant is first-class in every particular, and consists of a single-end Scotch marine boiler with three suspension furnaces, a surface condenser with horizontal air pump and centrifugal circulating pump, feed-water heater, the feed pumps, the filters, fresh water tanks and an electric light unit.

The levers, which are led to the operating platform, located forward on the main deck, are: For the main hoisting engine —reverse, hoisting clutch, brake and throttle; backing engine— backing clutch and throttle; for the swinging—reverse valve and brake; for each forward spud—reverse lever, brake and clutch. A cranesman operates the dipper door latch cylinder and the friction discs on the shipper shaft. The stern spuds are operated by a man on the after deck in obedience to signals from the runner. Wherever any force is required the levers at the operating stand simply operate the valves of steam cylinders, which are connected to the mechanism governed by the lever. In this way there is less fatigue to the operator of this dredge than is usually the case on a 1-yard dredge. It will be seen that with a scow on one side of the dredge being loaded, the entire dredge is controlled by four men; namely, the dredge runner, the cranesman, the stern spud operator and the operator in charge of the scow winches. In addition to these men the crew consists of a captain, the oilers, water tenders, firemen, deck hands and cook.

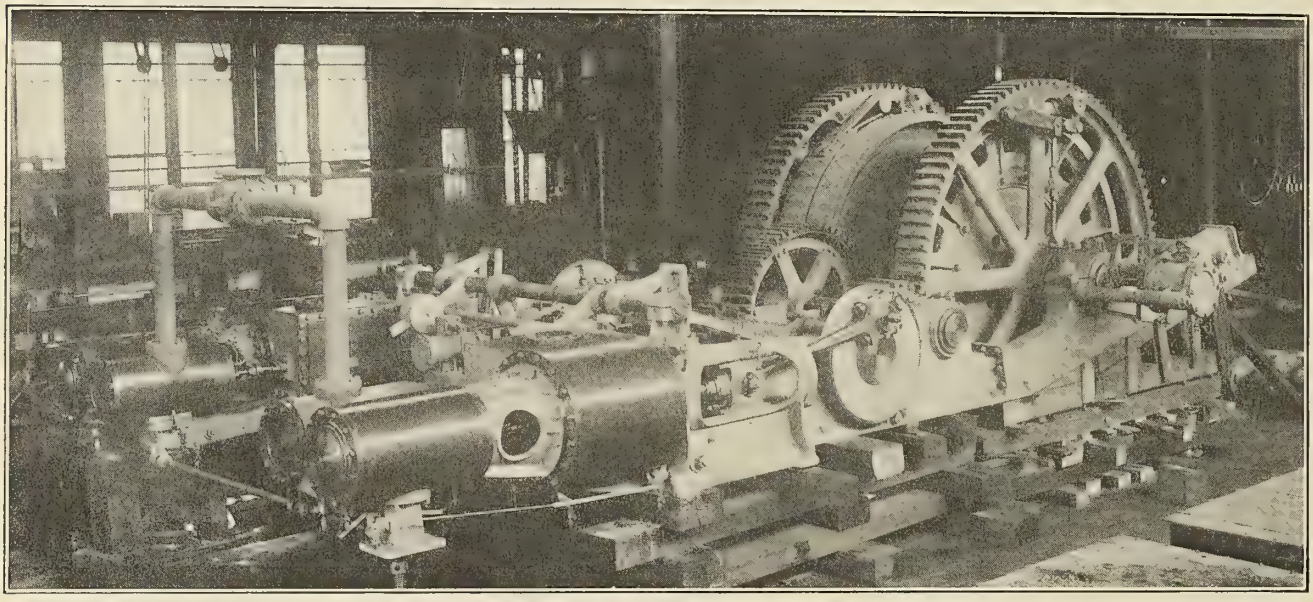


FIG. 4.—MAIN HOISTING ENGINES OF THE TOLEDO.

The dredge is capable of digging a dipper load each minute. This would, theoretically, amount to a capacity of 900 yards per hour, but it is, of course, necessary for the dredge to move up in the work, and there is considerable loss of time in getting scows alongside, so that this capacity is cut down to from 500 to 600 yards per hour, and the average over long periods will run down to perhaps 350 yards per hour on account of the delays due to heavy weather, most of the work being in a very exposed position.

The deck winches for warping the scows have three drums, one for a stern line, one for a bow line and one breasting line. About the deck are placed spools, bitts, etc., for convenience in leading lines. Under the main deck aft are the coal bunkers.

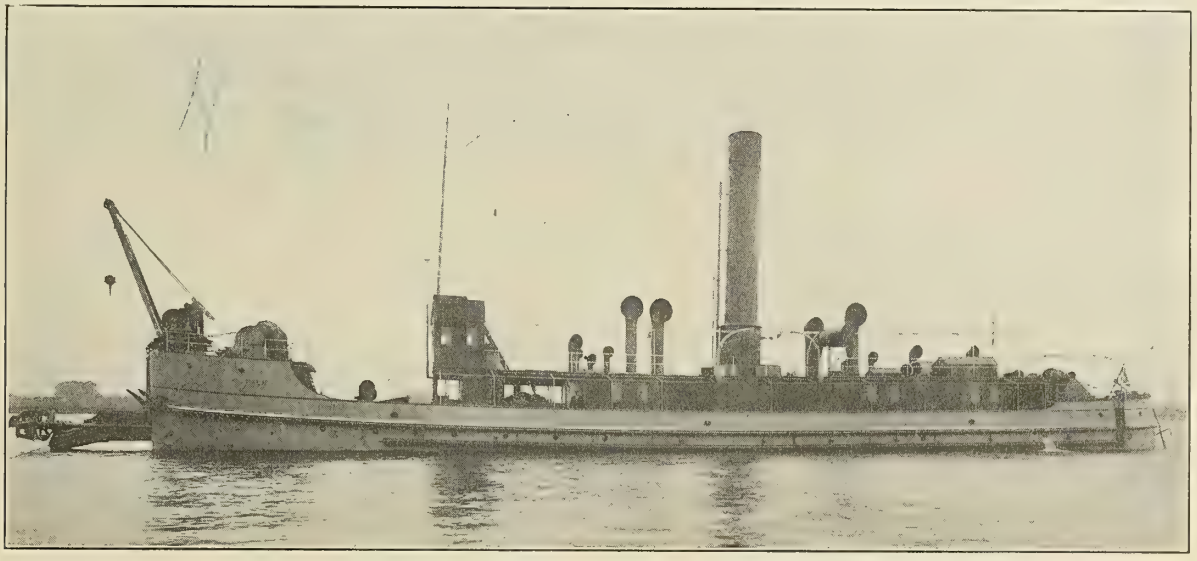
Practically all of the castings on the dredge are steel castings of unusually high tensile strength, and each unit of machinery is self-contained, to the extent that it is mounted on heavy base castings, which are in turn bolted to the timber framework. This means that the machinery cannot get out of line and that the gears all mesh properly, giving long life to the moving parts and a minimum of breakdowns.

The fitting out and finish of the dredge throughout, both inside and out, have been given more attention than is usually the case, with the result that the appearance is very shipshape. This dredge was built by the Bucyrus Company, of South Mil-

waukee, Wis., for the firm of George H. Breymann & Bros., of Boston and Toledo. Owing to the great length of the boom and dipper handle, it is impossible to dig a shallower channel than 20 feet deep. For this class of work, however, this fact does not limit the use of the machine in any way. The spuds are set back from the bow a sufficient extent to prevent the dipper from interfering with the spud feet. The angle of swing is very large, considering the size of parts, amounting to 157 degrees.

SEA-GOING SUCTION DREDGER PHARAON II.

This suction dredger, which was ordered by the Suez Canal Company from Werf Gusto, firm A. F. Smulders, Schiedam, Holland, with a view to studying exhaustively the problem of suction dredging and pumping in connection with the various kinds of soil which are met with in the canal, and which vary from soft mud and loose sand to stiff clay, hard marl, and even chalky rock, is fitted with a force pump and a patented cutter head, and is propelled by triple screws.



SUCTION DREDGER PHARAON II., BUILT IN HOLLAND FOR THE SUEZ CANAL COMPANY.

The principal dimensions of the dredger are as follows:

Length	170 feet
Breadth	30 feet
Depth	11 feet 6 inches
Draft	9 feet 2 inches
Dredging depth	39 feet 6 inches

The vessel is provided with five compound engines aggregating 1,250 indicated horsepower. Two of these engines are intended to drive each one propeller or each one of the sand pumps. The third engine drives a central screw, and the fourth and fifth engines move the cutter head. The vessel is further provided with three steam winches, a dynamo engine for lighting the dredger by electricity throughout, and a 10-ton steam crane placed at the bow, intended to facilitate the handling of the cutter head and the suction pipe mouth piece.

Steam for all the above named engines is supplied by two marine boilers having each a heating surface of 2,050 square feet and a working pressure of 120 pounds per square inch gage.

The dredger has two sand pumps, which may work in parallel or in series. The suction pipe is mounted on a strong ladder placed in a central well forward. This ladder carries the cutter and the cutter shaft, which is moved by tooth gearing located in the vessel. When sucking very hard soil the dredger is pressed forward against the front of the soil to be removed by means of the bow winch and the central screw already referred to.

The dredger is capable of sucking from a depth of 40 feet and of forcing the spoil away to a distance of 2,000 feet and a height of 20 feet. The forcing away is effected either athwartships at the starboard or port side through an elevated conduit ascending vertically from the dredger's deck or aft through a floating pipe line. The dredged material may also be discharged directly into barges moored alongside.

Since the *Pharaon* was designed to dredge all sorts of soil and to force it away under all possible conditions, she is necessarily a very complicated piece of work. It may be said that the results obtained have proved the possibility of working by means of suction dredging varieties of soil which it was formerly held could not be handled by suction methods.

GOLD DREDGERS.

Free alluvial gold, platinum and other minerals are found in almost every part of the world, and in most cases dredging is the cheapest and most expeditious means of recovering them. For this class of work a special type of gold dredge has been developed, a large number of which Mr. Arthur R. Brown, of 54 New Broad street, London, has supplied to various parts of South America, Africa, Russia and Siberia. These gold dredges are capable of treating an enormous quantity of ground at a very small cost. The gravels are dredged, in many cases, from a depth of 50 feet, passed through a screen onto tables on which the gold is deposited, and the debris stacked behind the dredge for a total cost of about 2 cents (one penny) per cubic yard. A view of these dredges, while under construction at the builder's works in England, is shown in Fig. 1. This is the sixth gold dredge which Mr. Brown has supplied to Tierra del Fuego, and it was guaranteed to have an actual working capacity of 2,000 cubic yards per day, dredging from a depth of 45 feet below the water level. It is fitted with built-up steel buckets of six cubic feet capacity, the machinery is driven by a compound surface condensing engine of about 80 indicated horsepower, and the boiler is of special design to burn peat fuel. These dredges work day and night, being lighted by electricity generated on them. The dredge, after complete erection at the builders, is taken to pieces, shipped to its destination, and then re-erected.

When the dredge is erected, all of the machinery is covered in by a corrugated iron house, as shown in Fig. 2, which is a view of a similar dredge at work in Tierra del Fuego. Fig.

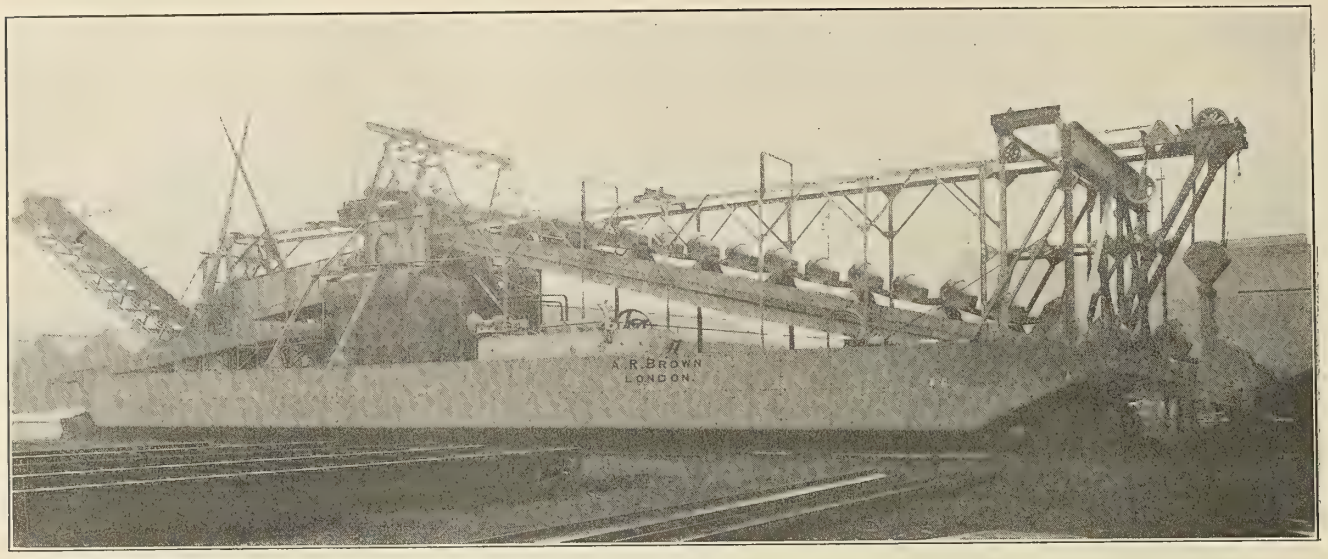


FIG. 1.—GOLD DREDGER UNDER CONSTRUCTION AT THE YARDS OF A. R. BROWN, LONDON.

2 is of peculiar interest, as it shows the dredge working before the ice has melted. In the winter the dredge is frozen up, but as soon as the ice melts sufficiently to enable it to be broken round the dredge, dredging can be resumed. The illustration shows men on the ice, which was 3 feet thick, breaking it round the sides of the dredge; these dredges have worked continuously all through the summer season, averaging 23 hours per day, and are paying handsome profits on ground which contains only 11.5 cents (5¾ pence) worth of gold per cubic yard.

Where the ground to be dredged is deep, or banks above the water level have to be dredged, it is necessary to use a screen and an elevator dredge, similar to those shown in Figs. 1 and 2, but in cases where the dredging depth is not great a simpler and cheaper form of dredge can be used, known as a sluice-box dredge, in which all of the material dredged passes down the sluice box direct from the buckets without screening or elevating. The depth to which a dredge of this kind can work depends on the height to which the tailings stack without touching the end of the sluice; in most cases gravels occupy one-third more space or height when stacked, consequently if a dredge is dredging 20 feet of ground level with the water the tailings will stack 10 feet above. A sluice box cannot be conveniently arranged to deliver more than about 8 to 10 feet above the waterline and, therefore, when the tailings stack to a greater height it is more convenient to have a tailings elevator.

Some exceptionally good returns have been obtained from small sluice-box dredges. A small prospecting dredge, with buckets of only 2½ feet capacity, which Mr. Brown supplied to West Africa, has been averaging 300 ounces per month, the total cost of the whole outfit being only $14,600 (£3,000). Considering the size of this dredge, the return is exceptional, but, of course, larger dredges have returned very much more. For instance, two dredges supplied by Mr. Brown to a Russian company in the Urals (Siberia) returned from April 9 to October 25, 1909, $353,275 (£72,555) worth of platinum. These two dredges are very powerful 7-foot bucket dredges,

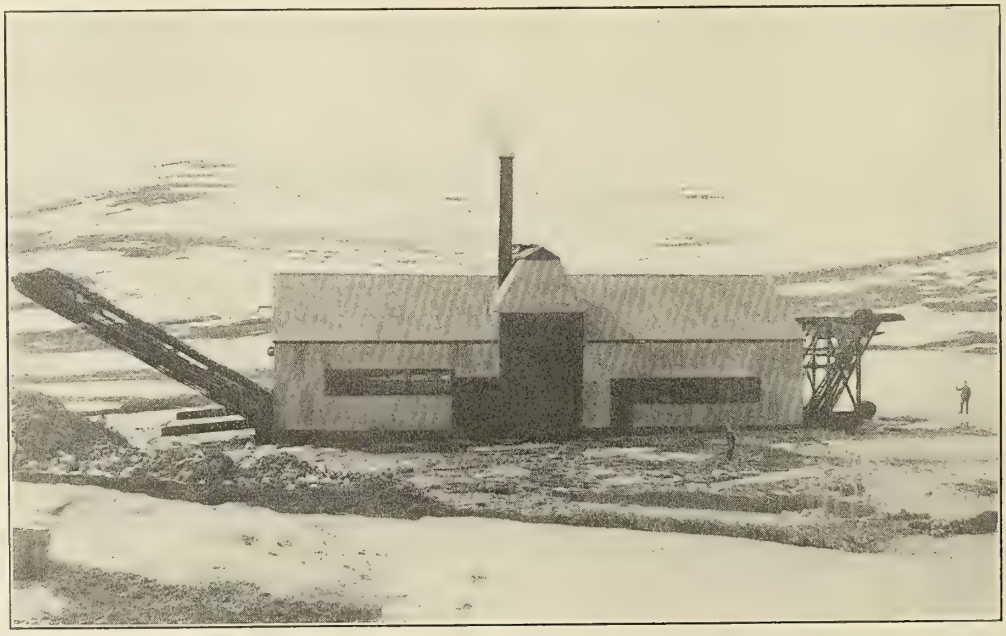


FIG. 2.—ONE OF BROWN'S GOLD DREDGERS AT WORK IN TIERRA DEL FUEGO. THE ICE IS 3 FEET THICK AROUND THE DREDGER.

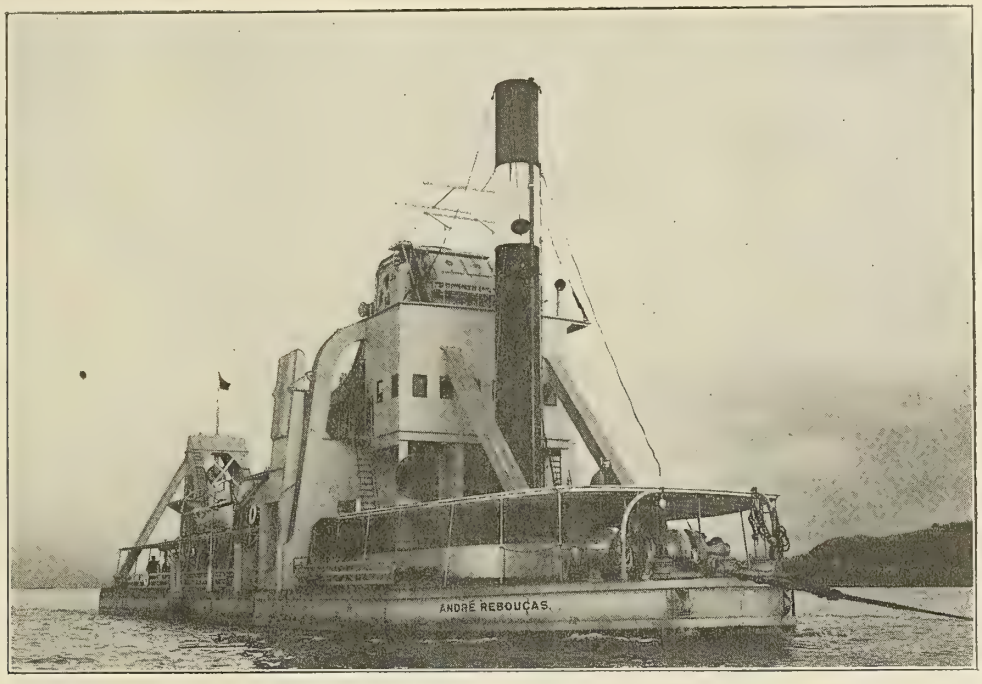
with special buckets for dredging through stiff clay, and also special arrangements for breaking up the lumps of clay in the screen. The total cost of the two dredges erected on the claim in Russia was $121,660 (£25,000), so that in 6.5 months they recovered nearly three times their total cost. It is usual in Russia for the dredges to only work about five months of the year, owing to the ground being frozen up, but in the case of these dredges, due to an exceptionally mild winter, they have been able to work all through the winter, and are still at work. Owing to these splendid returns, Mr. Brown received an order from another company for a similar dredge at the end of December last, which he shipped to the Urals within ten weeks of receiving the order.

Mr. Brown has supplied a number of other gold dredges to Liberia, some of which are paying very well on ground worth only 12 cents (6 pence) per cubic yard, and that during a short summer season; a dredge can only pay under these conditions provided it is designed to do the greatest amount of work on the least expenditure for fuel and repairs.

Gold dredges, although similar to harbor dredges in so far that they raise the material by means of a chain of buckets on a ladder which is raised and lowered by means of a winch, require special experience only obtained from actual working before they can be designed to do their work in the most efficient manner. Every gold dredge should be specially designed to suit the special requirements of the ground where it has to work. It is, therefore, a fatal mistake to supply gold dredges of a stock pattern, and a failure is sure to result if dredges are supplied unsuitable for the ground where they have to work.

For gold saving the suction dredge in many instances is not efficient; the pump not only requires very much more power to raise the same amount of material than the bucket, but if the surface of the bottom is uneven the gold is not lifted but is left in the crevices or hollows. In certain cases, however, a suction dredge is the best and most convenient type, as in a place in South America, where the tailings from a disused Spanish mine were found to have been washed into a large hole in a river bed. In this case Mr. Brown supplied an electrically-driven silt pump, mounted on a floating pontoon, which pumped these concentrates through 300 feet of floating pipe into cyanide tanks on the river bank. The capacity of the cyanide plant was only about 100 tons a day, but as the value of the gravels pumped amounted to over 2 ounces to the ton, the returns have been exceptionally good.

Mr. Brown is also building a special design of small bucket dredge, costing only a few hundred dollars, for dredging canals, swamps, and clearing out lakes or ornamental ponds, designed for transport in small pieces, the motive power being either gasoline (petrol) or kerosene (paraffine) motor or steam. The cheapest motive power, however, is producer gas, and in most cases where charcoal can be made it has been found to be the most convenient for use on a dredge. The gold dredges in Burmah are working most successfully with producer gas plants, the charcoal being purchased from the natives; in South America, at altitudes where no wood could be obtained, charcoal has been made out of a scrub growing a few inches above the ground, and gold dredges have worked there with producer gas with as low a consumption as one pound of charcoal per indicated horsepower per hour. The cost of the producer gas plant is not more than a compound condensing engine and boiler of the same power.



NON-PROPELLING BUCKET DREDGER ANDRÉ REBOUCAS.

André Rebouças.

We illustrate herewith a powerful bucket dredger, the *André Rebouças,* constructed by Lobnitz & Co., Ltd., Renfrew, Scotland, for the port of Para. This dredger was ordered March 11, 1909, the keel was laid April 11, and the vessel was ready for trial July 9, 1909; thus she was completely built and delivered within four months from the time of passing the order, a feat which is considered a record in rapidity of construction for this class of vessel.

The dredger is of the non-propelling type, very stiffly and powerfully constructed for dredging to a depth of 46 feet below water level in hard material, for which purpose the 600 horsepower dredging engines are situated high up near the top of the tumbler, and their gearing is designed in so simple a manner that one may say they practically act directly upon the buckets, and thus work with the greatest possible efficiency in dealing with hard material. The huge shaft of the

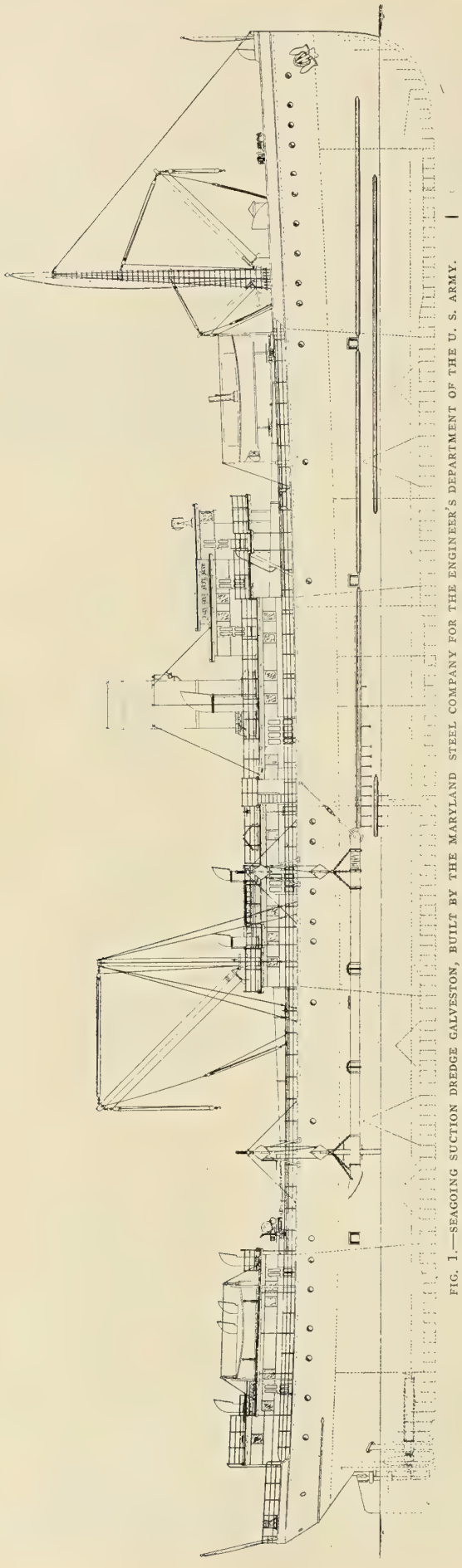


FIG. 1.—SEAGOING SUCTION DREDGE GALVESTON, BUILT BY THE MARYLAND STEEL COMPANY FOR THE ENGINEER'S DEPARTMENT OF THE U. S. ARMY.

tumbler over which the buckets turn at the top is of solid steel 19½ inches in diameter, similar to that of the great dredger *Péluse,* owned by the Suez Canal Company. All the gear wheels have their teeth machine cut from the solid steel.

SEA-GOING SUCTION DREDGES.*

BY THOMAS M. CORNBROOKS.

During the past five years the engineers' department, United States army, have contracted for a number of sea-going suction dredges. These have been of varying sizes, ranging from 166 feet to 300 feet long, the capacities of bins ranging from 1,000 to 3,000 cubic yards. As the design of all these dredges has been similar, the description of one will apply to all. The latest dredge is the *Galveston,* just completed at the works of Maryland Steel Company, Sparrow's Point, Maryland. As will be seen by the plates the dredged material is carried in two large bins, one forward and one aft of the machinery space.

In operating, the dredge is kept moving forward at a speed of about 6 knots, with the suction pipes dragging on the bottom. The material is sucked up by 20-inch centrifugal pumps and discharged into bins, through pipes and distributing chutes on top of bins. By means of gates in bottom and sides of these chutes it is possible to distribute the material evenly. As the bin fills the water is drained off by overflows through the sides. When the bins are filled the dredge proceeds to the dumping grounds and, opening the gates in bottom, drops the material. The gates are operated by means of a double-cylinder vertical engine through worms and fixed nut on vertical rods.

The officers and crew have commodious quarters in houses on deck and on the lower deck forward and aft.

The propelling machinery consists of two compound engines, steam for which is furnished by four single-ended boilers.

In trying these dredges, we have discovered that a very large rudder is necessary. This we ascribe to the shafts being so far outboard and the extreme fullness of the after body.

In Fig. 3 will be seen the curves of bending moments, etc., and equivalent girder, for the latest New York harbor dredges *Raritan* and *Navesink.* It will be noticed that the neutral axis of girder is very low, showing that the material is not distributed to the best advantage.

The bending moment for hogging works out $\frac{L \times D}{47.34}$, and the stresses, tension in sheer strake, 4.22 tons; compression in keel, 2.73 tons.

On the two dredges, *Ancon* and *Culebra,* built for the Isthmian Canal Commission, we located sights and measured the deflection under load. On loading for the first time, a deflection of 5/16 inch in 200 feet was recorded. This returned to within 1/16 inch of original marks when the load was dumped, which would indicate that the structure is amply stiff.

On these dredges we also conducted inclining experiments, memoranda of which are given below:

Draft forward, 10 feet 4 inches.
Draft aft, 11 feet 9 inches.
Displacement, 2,375 tons.
Conditions:
Bilges, dry.
Water tanks, full.
Boilers, full.
Workmen on board, 30.
Bunkers, half full.
Hopper gates, open.
G. M., 7.187, as inclined.

* From a paper read before the American Society of Naval Architects and Marine Engineers, New York.

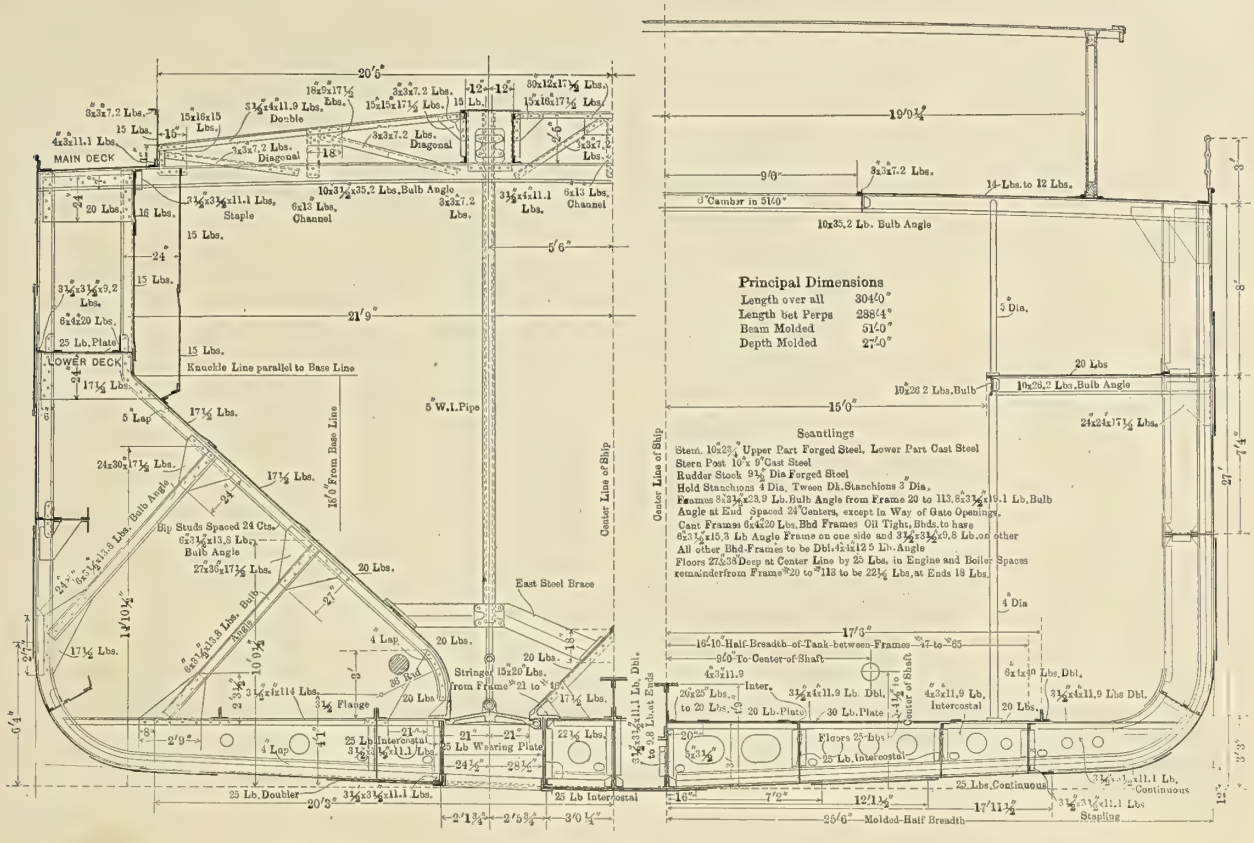

MAIN DECK
LOWER DECK
Principal Dimensions
Length over all 304'0"
Length bet Perps 288'4"
Beam Molded 51'0"
Depth Molded 27'0"
Scantlings
Stem. 10"x3¾" Upper Part Forged Steel, Lower Part Cast Steel
Stern Post 10"x 9" Cast Steel
Rudder Stock 9⅛" Dia Forged Steel
Hold Stanchions 4 Dia, Tween Dk. Stanchions 3" Dia.
Frames 6"x3½"x23.9 Lb. Bulb Angle from Frame 20 to 113, 8"x3½"x19.1 Lb. Bulb Angle at End Spaced 24" Centers, except in Way of Gate Openings.
Cant Frames 6"x4"x20 Lbs. Bhd Frames Oil Tight, Bhds. to have 6"x3½"x15.3 Lb Angle Frame on one side and 3½"x3½"x9.8 Lb. on other
All other Bhd-Frames to be Dbl. 4"x4"x12.5 Lb. Angle
Floors 27"x35" Deep at Center Line by 25 Lbs. in Engine and Boiler Spaces remainder from Frame 20 to 113 to be 22½ Lbs. at Ends 18 Lbs.
Center Line of Ship
East Steel Brace
Stringer 15"x20" Lbs. from Frame 21 to 105
Knuckle Line parallel to Base Line
5" W.I. Pipe
From Base Line
Half-Breadth-of-Tank-between-Frames 47 to 65
240" To Center of Shaft
Inter.
Floors 25 Lbs.
25 Lb. Intercostal
25 Lb. Plate
30 Lb. Plate
25 Lb. Doubler
25 Lb Intercostal
25 Lb Wearing Plate
25 Lbs. Continuous
Stapling
Molded-Half Breadth

FIG. 2.—SECTION THROUGH AFTER BIN AND MIDSHIP SECTION OF THE GALVESTON.

Trans. B. M. = 20.4 feet.
Trans. C. B. = 5.53 feet.

25.93
7.19

18.74 = C. G. above base.

Loaded:

Hull, 2,375 tons.
Load, 3,085 tons (at 128 pounds per cubic foot).
Corrected C. of G., 18.14 feet.
Met. above base = 20.8
C. G. above base = 18.14

2.66 = G. M. loaded.

The percentage dredged depends on the quality of material, and ranges from 10 to 60 percent. The dredges start out at 5 A. M. Monday, summer and winter, and do not return to dock until noon on Saturday.

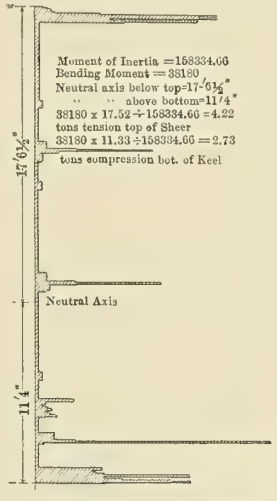

Moment of Inertia = 158334.66
Bending Moment = 38180
Neutral axis below top = 17'6½"
" " above bottom = 11'4"
38180 x 17.52 ÷ 158334.66 = 4.22 tons tension top of Sheer
38180 x 11.33 ÷ 158334.66 = 2.73 tons compression bot. of Keel
Neutral Axis

FIG. 4.—EQUIVALENT GIRDER.

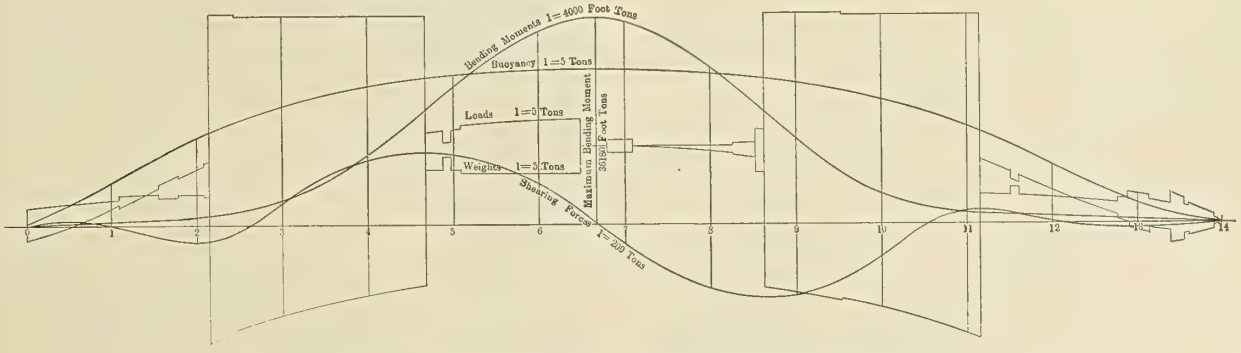

Bending Moments 1=4000 Foot Tons
Buoyancy 1=5 Tons
Loads 1=5 Tons
Weights 1=5 Tons
Maximum Bending Moment 38180 Foot Tons
Shearing Forces 1=200 Tons

FIG. 3.—CURVES OF BENDING MOMENTS, U. S. DREDGES RARITAN AND NAVESINK.

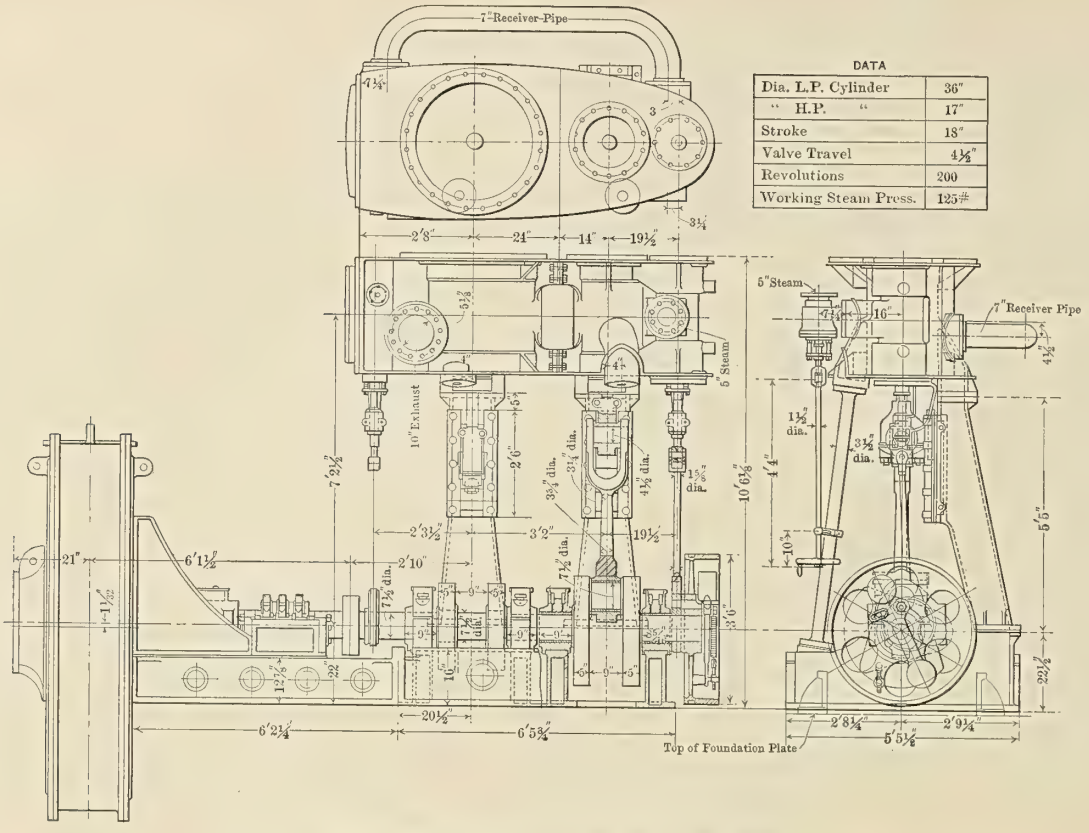


FIG. 5.—PUMPING ENGINE AND PUMP OF U. S. GALVESTON.

The *Manhattan* and *Atlantic* worked twenty-four hours per day from June 1, 1907, to Feb. 1, 1908, and only averaged forty hours per month lost time for repairs, bad weather and coaling.

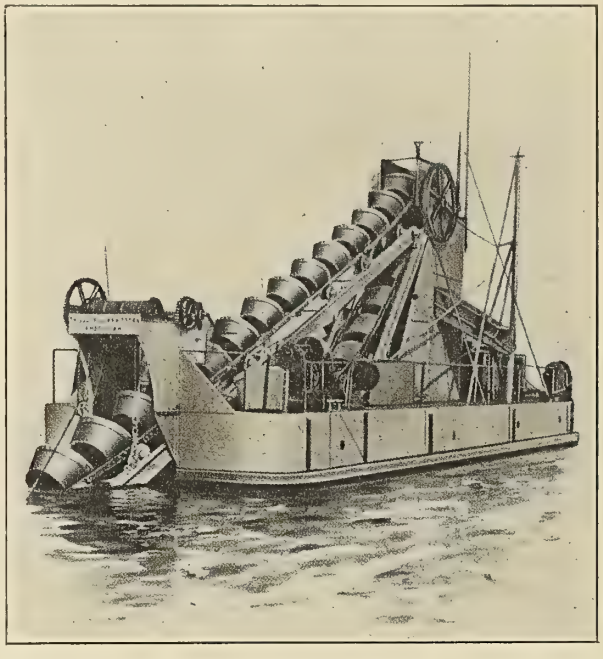
Below is the record of *Raritan* for ten days previous to July 31:

Number of loads, 44.
Cubic yards material pumped, 117,666.
Pumping time, 7,465 minutes.
Turning, 415 minutes.
Running to dump, 2,225 minutes.
Dumping, 490 minutes.
Returning to grounds, 1,685 minutes.
Pumped per minute average, 15.8 cubic yards.
Time at dock, 23 hours.
Minor repairs, 12 hours 20 minutes.

A Dutch Motor Dredge.

A dredger operated by a suction gas motor has recently been built by the Holland Motor Company, of Amsterdam, Holland. The vessel is constructed of steel and is 42.9 feet long, with a beam of 13.1 feet. The power plant consists of a single-cylinder Holland motor of 10-inch bore and 12-inch stroke, capable of developing 25 brake-horsepower at 280 revolutions per minute. Duplicate ignition, consisting of both a hot tube and a Bosch magneto, is fitted to the engine. Gas for the engine is developed by suction gas producer, using hard coal as a fuel. It is claimed that this installation is much simpler and more economical than a steam plant, and that it permits a reduction of the operating force, since only three men have to be employed instead of five.

The capacity of the dredger when working in soft ground is 786 tons for a ten-hour working day. When working in hard ground this is reduced to 590 tons. The weight of hard coal used during this period is 171 pounds, which in Holland costs about 48 cents (2 shillings). Assuming that the engine is working all day at full capacity, the weight of coal used per brake-horsepower per hour would be .71 pound, while the cost of fuel per brake-horsepower hour would be .2 cent (.1 penny). This figure is low, even for a suction gas motor, but it must be remembered that coal costing only $6 (25 shillings) per ton is being used.

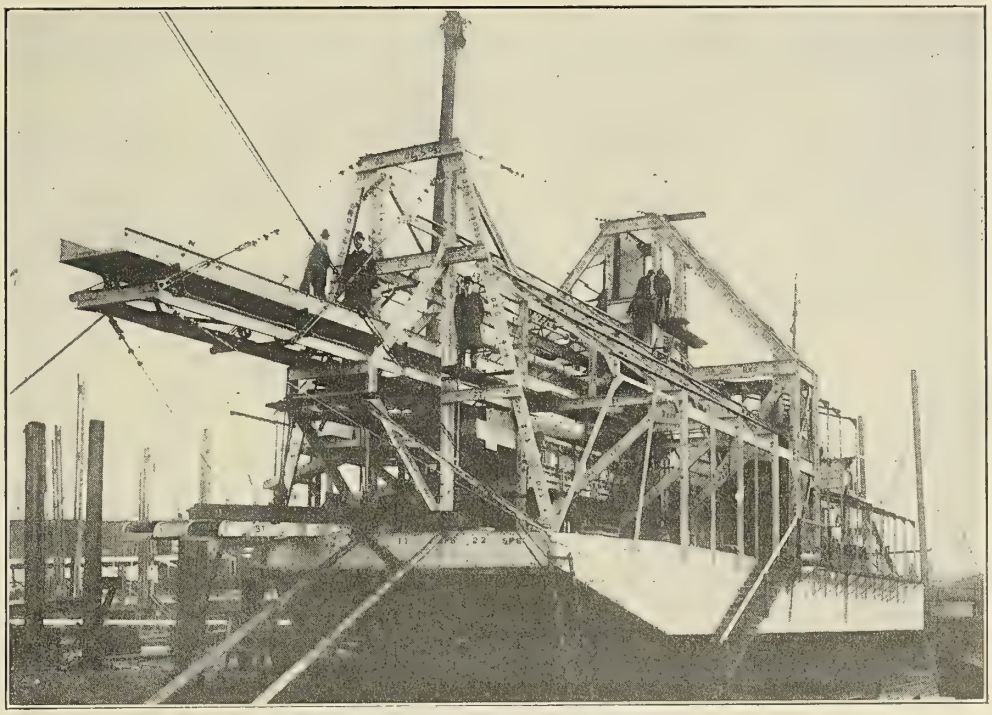


SUCTION GAS MOTOR DREDGE.

The British navy estimates for the present year call for five battleships of the dreadnought type, five protected cruisers of 25 knots or over, twenty destroyers, a number of submarines, and two floating docks.

A NEW TYPE OF GOLD DREDGER.

The gold dredger shown herewith is one of five similar dredgers built by Messrs. Lobnitz & Co., Ltd., Renfrew, Scotland, during 1909, all of which were fitted with what is known as the patent propulsion screen, a device designed and patented by Messrs. Lobnitz & Co., Ltd., to obviate the use of costly revolving screens and elevators. It is claimed that with the propulsion screen the gravel is much more efficiently treated, and is discharged as high as required behind the dredger.



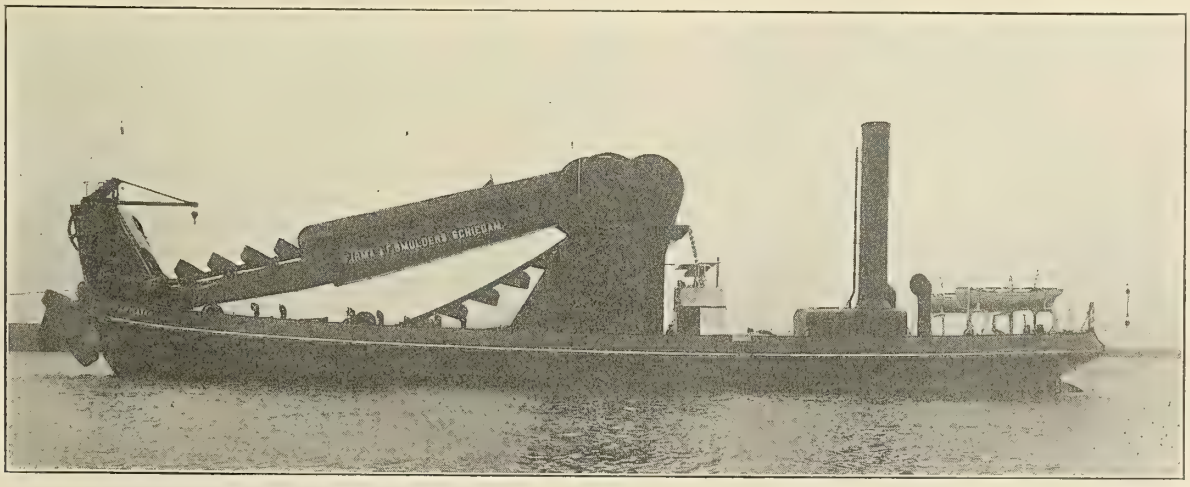
GOLD DREDGER FITTED WITH PATENT PROPULSION SCREEN.

The dredger shown in the illustration was built to the order of the Inambari Gold Dredging Company, Ltd., under the direction of the company's consulting engineers, Messrs. Ider & Henderson, of London. After being erected at the builders' works, the dredger was dismantled and shipped to Mollendo, and thence by rail to Tirapata. From Tirapata to the claim on the Inambari River the transport had to be done by mules, owing to the mountainous character of the country. For this reason the bulk of the material used in the construction of the dredge had to be arranged so that the dimensions of the packages should not exceed 6 feet by 2 feet 6 inches, and also that the weight of each should not exceed 165 pounds. In a few cases when parts of machinery could not be reduced to this weight special carts were designed and shipped out along with the dredge to transport these special parts over the difficult roads.

The hull of the dredger is of steel, 102 feet long, 30 feet wide and 6 feet deep. The buckets have a capacity of 4¼ cubic feet each, and the dredge is capable of efficiently treating 1,500 cubic yards of gravel per day. The bucket ladder is arranged for a dredging depth of 35 feet below water level.

SEA-GOING TWIN SCREW BUCKET DREDGER.

The seagoing twin-screw barge loading bucket dredger *La Plata,* ordered from the Werf Gusto, firm A. F. Smulders, Schiedam, Holland, for deepening the port of Rosario, has



TWIN SCREW BARGE LOADING BUCKET DREDGER BUILT BY A. F. SMULDERS, SCHIEDAM, HOLLAND, FOR THE RIVER PLATE.

been built under special survey of the Bureau Veritas in order to receive the highest classification. The hull, which is divided into nine watertight compartments, has the following main dimensions: Length, 169 feet; breadth, 30 feet 6 inches; depth, 12 feet 6 inches. The well is aft, with a projecting ladder, so that the vessel can cut her own flotation.

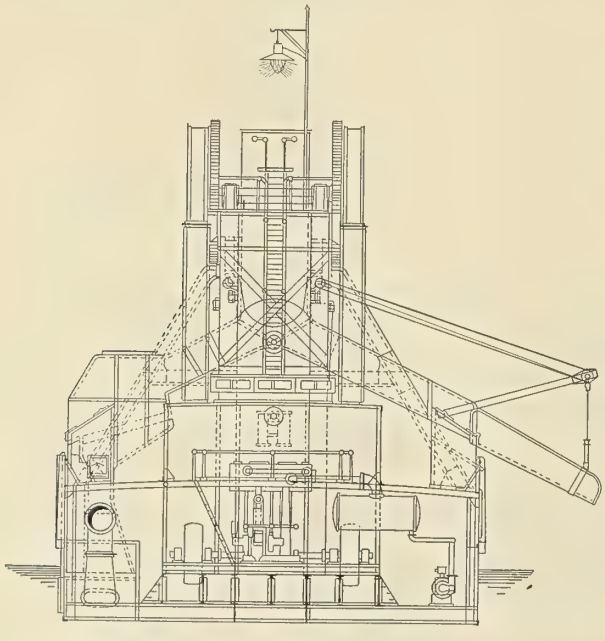
There are two main engines of the vertical compound type, developing 260 indicated horsepower each. Both engines drive the propellers, while each engine may separately drive the bucket chain. The vessel is further provided with five steam winches, namely: one bow winch, two fore-side winches, one aft winch, one ladder hoisting winch and one chute hoisting winch. The vessel is also supplied with a dynamo engine, and the lighting is by electricity throughout.

All of the main and auxiliary engines are supplied with steam by two marine boilers, each having a heating surface of 1,290 square feet and a working pressure of 120 pounds.

Dredging may be effected to a depth of 43 feet, and the effective output reaches about 650 cubic yards an hour. After having been submitted to exhaustive trials on the river Maas, the dredger traveled to the River Plate under its own steam.

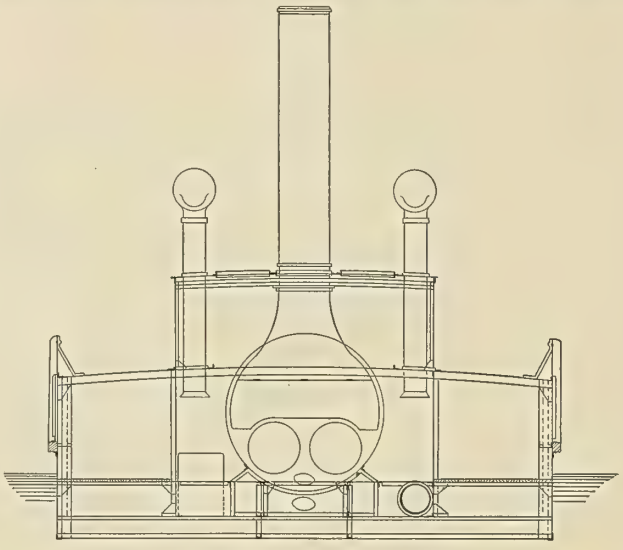
THE BUCKET AND PUMP DREDGER BRAILA.

Increasing traffic on the lower Danube recently led the Roumanian government to seek a more powerful dredger than those which had hitherto been available on the river. It was first planned to have constructed a large suction dredger with cutter arrangement. The principal object of this design would have been to enable the dredge to operate at those points where temporary sand bars had been formed by the current and to clear away such obstacles to traffic in the shortest possible time, forcing the dredged material through a floating pipe line and depositing it outside the ordinary ship channel. Further consideration of the problem, however, showed that it would be better to secure a dredger of more general usefulness, which could also be used for some improvement and extension works in the harbor of Galatz. The nature of the harbor in that port, however, is such that it was considered doubtful whether a suction dredger, even when fitted with efficient cutting apparatus, could handle the work. Furthermore, it was desirable to have the dredger arranged for loading barges. As a result of the necessity of meeting these various requirements, it was finally decided to use a bucket dredger of the endless chain type arranged for loading barges, but also fitted with a powerful sand pump by which the material raised by the buckets could be forced away through a floating pipe line.



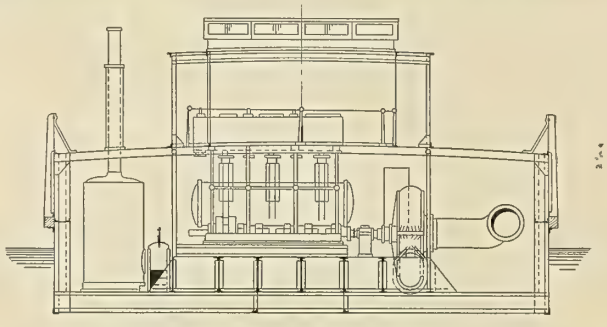
SECTION THROUGH MAIN FRAMING, SHOWING ARRANGEMENT OF CHUTES.

The contract for this dredger was placed by the Roumanian government with the Werf Conrad, Ltd., of Haarlem, Netherlands. The capacity of the dredger was stipulated in the contract to be 785 cubic yards per hour, and this was to be the actual output and not merely the digging capacity. The builders had to guarantee this output working in sandy clay and forcing the material brought up by the buckets to a distance of 1,300 feet with an elevation above the water at the end of the pipe line of 16½ feet. The trials which have been made with the dredger since she was completed have shown that she is capable of exceeding this guarantee by about 10 percent.



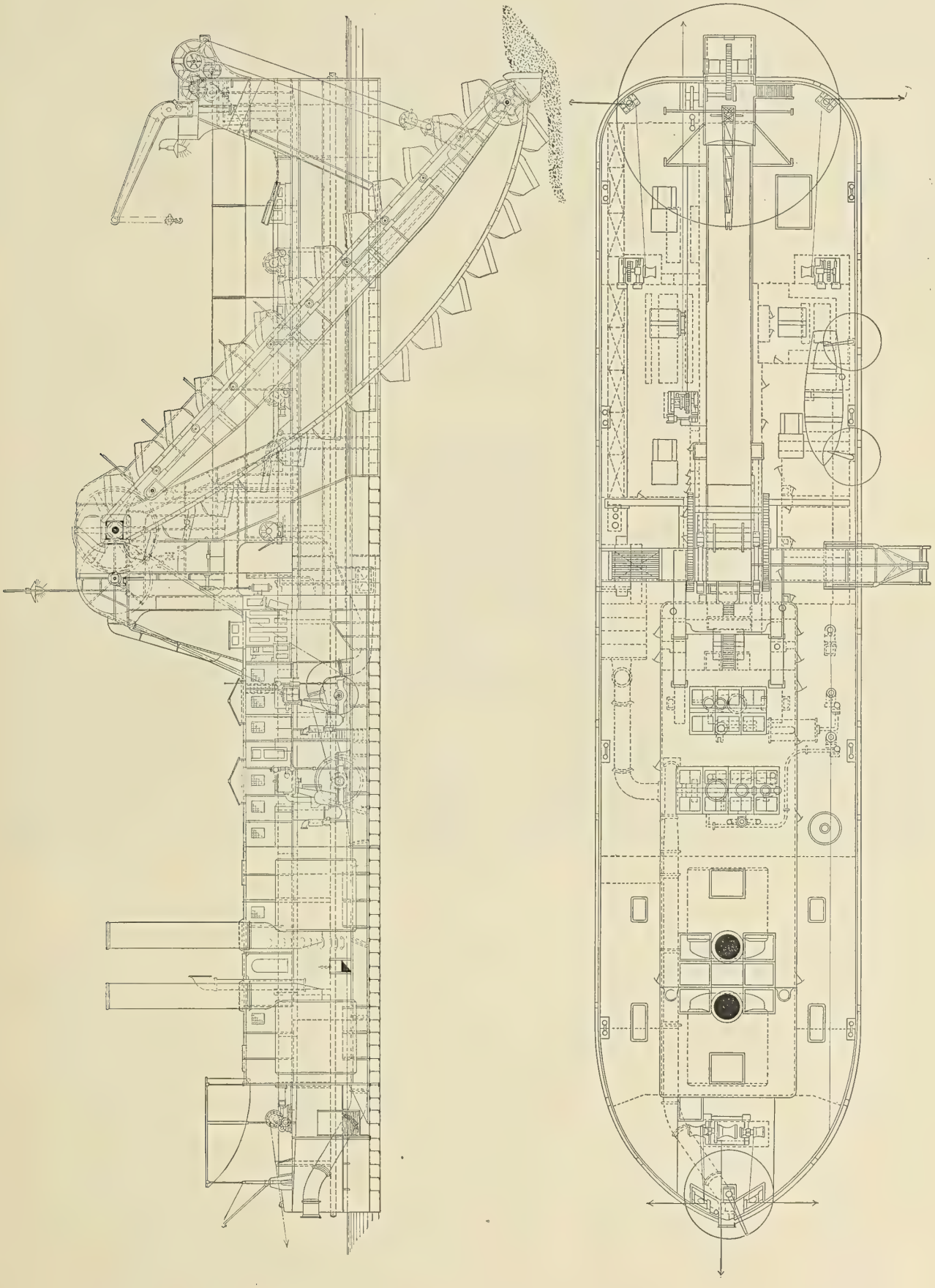
SECTION THROUGH BOILER ROOM.

The dredging depth of the vessel was fixed at 30 feet, so that she could be used for deepening the existing docks at Galatz. The principal dimensions of the dredger are: Length, 168 feet; width, 37 feet 6 inches, and depth, 12 feet 4 inches. It was stipulated by the government engineers of Roumania that the dredger in working order should not draw more than 5 feet of water. This is a very shallow draft for a dredger of this capacity, and it involved the necessity of building a relatively large hull in order to meet this requirement.



SECTION THROUGH ENGINE ROOM.

The dredger is fitted with two sets of engines, one of which is a vertical, surface-condensing, two-cylinder compound engine, which develops 385 indicated horsepower and drives the buckets, the connection between the engine and the bucket chain being by means of two belts. The other engine is of the triple expansion type, developing 500 indicated horsepower, and is used for driving the sand pumps. Steam is supplied at a working pressure of 160 pounds per square inch from two multi-tubular marine boilers having a total heating surface of 3,230 square feet. These boilers supply steam for both the main and auxiliary engines.



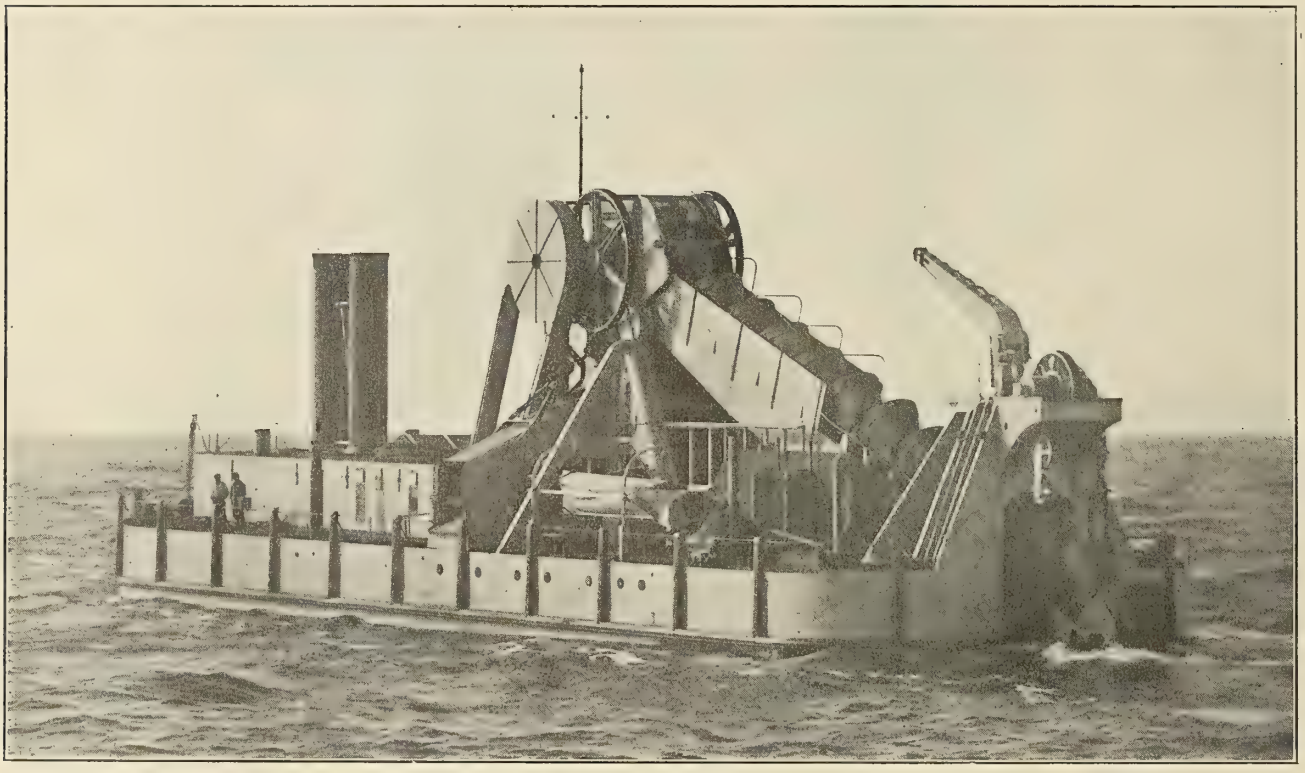
INBOARD PROFILE AND DECK PLAN OF THE BRAILA.

They are equipped for burning oil fuel, and although it is intended to use this kind of fuel as a rule, as most of the steamers on the lower Danube do, nevertheless coal bunkers have also been installed, and the furnaces can easily be arranged for burning either kind of fuel at short notice.

The auxiliary machinery includes two circulating pumps of the centrifugal type, each driven by a direct-connected, single-cylinder vertical engine. A steam-driven generating set is also installed in the engine-room to provide the necessary current for lighting the ship. There is also the usual equipment of auxiliary steam pumps for filling the boilers, emptying the bilges, washing the deck, etc., as well as injectors, bilge ejectors and a pumping plant belonging to the installation for burning liquid fuel.

Separate winches are located on deck for forward and side motions and for raising and lowering the bucket ladder. The roomy and well-ventilated cabins have been provided for the officers as well as excellent quarters for the deck hands and firemen. Comfortable quarters have been fitted on deck for the use of the government officers who have to stay on board the dredger. All of these different apartments, as well as the engine and boiler room, can be heated by steam, for which purpose a small donkey boiler has been placed on board.

The hull as well as the engines and boilers of this dredge have been built under Bureau Veritas Special Survey to the highest class for dredgers. The vessel was completed at the works of the Werf Conrad, at Haarlem, early in 1909, and after carrying out her preliminary trials she was towed out to the Black Sea, where her official trials were made on the Danube. These trials showed that the vessel was not only successful in every respect, but that her capacity exceeded the contract requirements of about 10 percent.



THE BRAILA BEING TOWED FROM HER BUILDERS' WORKS AT HAARLEM TO THE BLACK SEA.

three chains aft are worked from one combined three-barrel steam winch. The chutes are worked from a steam winch located under the main framing, and a set of direct-acting steam cylinders is fitted for working the door at the bottom of the central chute for delivering the dredged material on either side of the dredger into barges.

The buckets are of very strong design, and have a capacity of 35 cubic feet each. They are built up of steel plates and forged steel links, and are provided with hard steel lips. This construction was considered to be the best in this case, and to provide greater advantages than cast steel buckets, since great solidity and strength could be obtained with less weight than would have been required with a chain of cast steel buckets. This saving in weight was desirable on account of the shallow draft which, as has been stated, was stipulated in the contract.

The very light draft for which the vessel was designed has the enormous advantage that the dredger can be easily towed over sand bars and reach any place where a bar has been formed by the current. On the other hand, the size of the hull necessitated by this very light draft leaves ample room for spacious accommodations for the crew. Consequently, large,

A Broken Stern Gland.

We left our pier in New York bound for Liverpool one morning in May, 1909, in a ship which travels at the rate of 26 knots, but we had proceeded only a short distance when one of the shaft oilers reported to the engineers on watch that something was wrong in the starboard high-pressure room. I must mention that this ship was propelled by turbines. It appears that before leaving the pier the stern gland on the starboard high-pressure shafting had been screwed up a little, as it was admitting water into the bilges. Those who know anything of turbines will know that they start off at a high speed. A jet of sea water was running on the gland from a water-service pipe, but as it turned out this was not enough to keep it cool. The gland became warmer and warmer although more water was applied to it, until it gave off steam. Finally it cracked with a jar. We made two steel bands and bolted them together round the gland. The gland was watched by two men who did six-hour watches all the way home, and I am glad to say the job carried up all right to Liverpool, where it was repaired. F. J. N.

DIPPER DREDGE FOR MONTREAL CONTRACTORS.

A 1½-cubic yard dipper dredge has recently been built by the Vulcan Steam Shovel Company, Toledo, Ohio, for Laurin & Leitch, No. 5 Beaver Hall Square, Montreal, Que. The new dredge is at present being used to dredge a channel for the intake pipe to the crib which is being built in connection with the city of Montreal waterworks.

The hull of the dredge is 80 feet long by 40 feet wide and 7 feet deep, and was built on the ground after plans furnished by the manufacturers of the machinery. The main engines are double 10 inches by 12 inches, piston valve, reversible engines without links, the valves being so set as to give maximum efficiency in the go-ahead position. The crankshaft is of hammered iron, and the pinion is of cast steel with cut teeth.

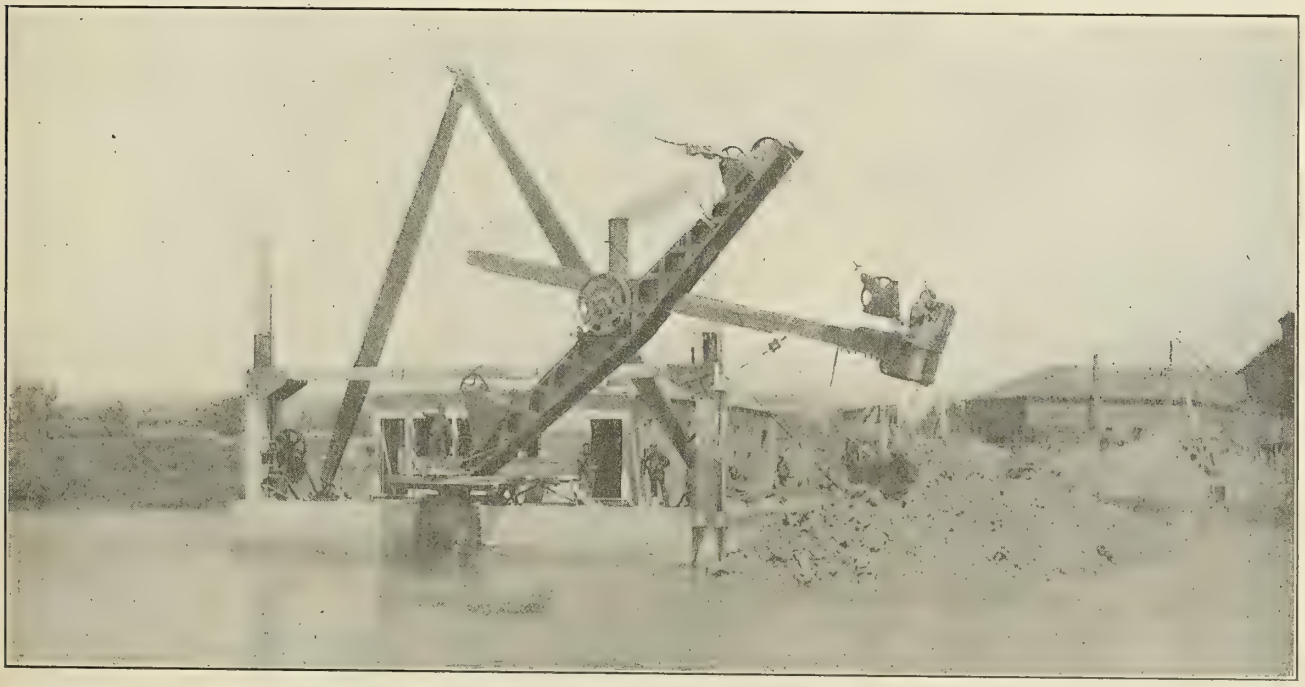
The hoisting gear is of cast steel with cut teeth. The hoist drum is of cast iron, brass bushed. It runs loose on the shaft, and has wide-faced flanges riveted to each end for friction and lowering brake bands. The drum has finished grooves for the cable. The hoist friction is of the outside band type, wood lined and controlled by a steam ram operated by a hand lever at the engineer's stand. The lowering brake is also of the outside band type, wood lined, and is controlled by means of a foot treadle at the engineer's stand. The drum shaft is of hammered iron supported in strong cast iron babbitted bearings with adjustable caps.

The swinging engines are 8 inches by 9 inches, duplex, slide valve, reversible engines, with the bed cast in one piece. The crank is forged and the crank-pin and cross-head pin bearings are of bronze. The swinging engine pinions are of forged steel with cut teeth. The intermediate gear is of cast steel with cut teeth. The swinging gear is of cast steel, with cut teeth, and is riveted to the drum. The swinging drum is of cast iron running loose on its shaft, and has finished grooves for the cable.

The backing gear is of cast steel with cut teeth, and is driven from the main engines. The drum is of cast iron, with brass bushings, and runs loose on the shaft. It is driven direct from the gear by means of an outside friction band, handled from the engineer's stand through hand lever and connections.

The bow anchors are raised by means of a rack and pinion, the pinion being driven through a train of gears and a steel sprocket chain with a friction device on a shaft under the deck, which in turn is driven by the backing shaft. The bow anchors are provided with strong cast steel locks for holding them at any desired depth. The stern anchors are of the walking type, with cradle and guide. These are operated by hand power. Two winches are provided on the deck, which are driven by gearing from the backing drum shaft.

The A frame is built up of channels, plates and bars, with a cast steel head, feet and steps. The head is provided with cast iron yoke brass bushed. The boom and back guide are of wire cable. The swinging circle is 16 feet in diameter, of structural steel with a cast steel brass bushed center, working in a steel step or base casting with a bronze collar between. The whole circle is thoroughly and substantially framed, and has proper provision for connection to the boom and to the swinging cable. The circle is carried at the deck level.



DIPPER DREDGE IN SERVICE AT MONTREAL, QUE.

The boom is of steel plates and shapes riveted up in the most substantial manner. The shipper shaft is of cast steel, and is furnished with brake-wheels 54 inches in diameter by 5-inch face, with wood-lined bands controlled by a foot pedal to the cranesman's stand. The boom is 38 feet long, center to center, and is stepped at the bottom in a strong steel casting, brass bushed, which works on a steel base plate with a bronze washer between. All hoisting and swinging sheaves are of cast steel, brass bushed, with pins of ample size to prevent undue wear. The dipper handle is of wood, steel armored.

The dipper is of 1½ cubic yards capacity, square, with four tool steel teeth, a cast steel back, cast steel lip, lugs and forged bail, braces and hinges.

The boiler is of the locomotive type, 66 inches in diameter by 14 feet long, covered with magnesia boiler covering. It is built for 125 pounds working steam pressure, and is supplied with water by means of an injector and steam feed pump.

Oil is supplied to all engines by means of a Hills-McCanna force-feed lubricating pump, insuring a constant and sufficient supply of oil at all times. All sheaves, bearings, etc., are fitted with dope cups of ample size. Each engine is also furnished with a hand oil pump and the ram and the pump are furnished with a lubricator.

It will be seen from the above description that the machinery is large enough to carry a 2½-cubic yard dipper for ordinary work, but inasmuch as the material at present being excavated is rock, the smaller dipper was substituted. The smaller dipper is more efficient for the present work.

NEW BUCKET DREDGERS FOR THE KAISER WILHELM CANAL.

Two bucket dredgers of the largest type afloat are being completed at the yards of Messrs. Sachsenberg Brothers at Rosslay (Anhalt, Germany) for the Imperial Canal Administration at Kiel. The dredgers are driven by steam engines, and will have an output of at least 17,660 cubic feet per hour while working uninterruptedly in compact sand, and with the buckets 70 percent filled as stipulated. The normal depth at which the material is dredged is about 40 feet; in this condition the bucket ladder has an inclination of 45 degrees to the horizontal. The point of suspension of the ladder can be shifted in order to attain a dredging depth of 46 feet. The bucket ladder is situated in a well, and in order to be able to dredge its own way projects ahead of the bow of the dredger about 15 or 16 feet. The dredged material is discharged in chutes, and received by barges lying at both sides along the dredger.

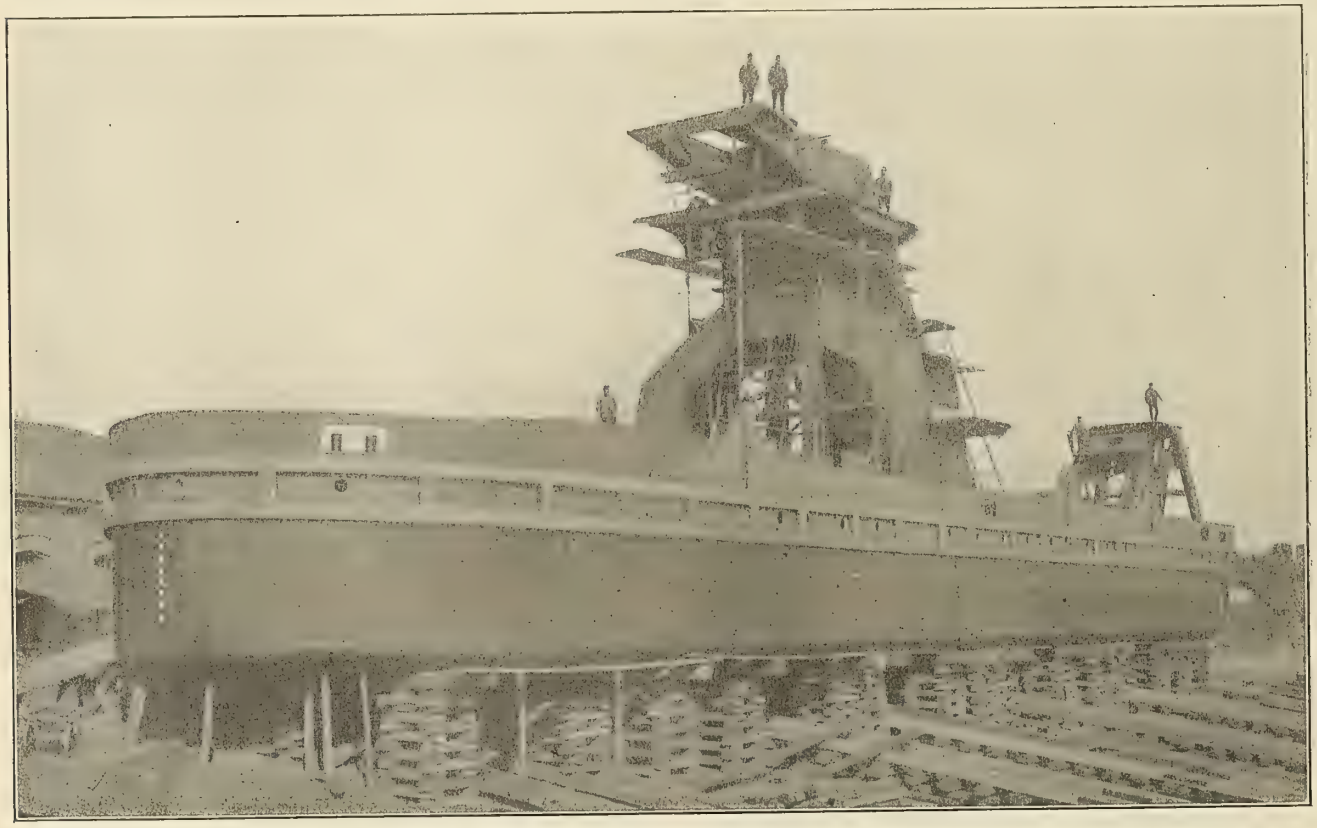


FIG. 1.—HULL OF NEW BUCKET DREDGER FOR THE IMPERIAL CANAL ADMINISTRATION AT KIEL, UNDER CONSTRUCTION AT THE BUILDERS' YARDS.

HULL.

The principal dimensions of the hull are as follows:

Length on load line	159.01 feet
Breadth molded	30.18 "
Depth, molded	11.48 "
Draft in working condition about	7.38 "

The hull is constructed of German mild steel, according to the regulations of the Germanische Lloyd Class 100 A. W. 4. The scantlings are indicated on the cross-section (Fig. 2). The riveting of the seams and butts of the outside plating and of the deck are overlapped. In order to distribute efficiently the strains on the engine and boiler foundations and the connections of the main-framing web frames, double reverse angles, extra deep floors, etc., have been provided. For the same reason a side stringer is constructed at about half the ship's depth on the outside plating. The deck is constructed of checkered steel of 3/16 inch thickness, and is well riveted to the beams. In order to maintain the buoyancy of the ship in case of severe damage of the outside plating of the well a gallery has been provided along it.

All around the whole vessel a double oak fender is fitted of 10 x 5 inches cross section, between strong angle-bars. Also vertical fenders of the same scantlings at every fourth or fifth frame. At four places on both sides the latter have been continued above the gunwale for about 6 feet 6 inches, and are efficiently connected to the ship's structure. The floor plates in the engine and boiler rooms and in the hold for the winches are made of checkered plates, which are easily removable for inspection of the bilges. In the galley and toilet the flooring is covered with cement tiles. In the other holds the flooring is of tongued and grooved yellow pine boards 1¼ inches thick. The walls of the cabins are paneled. The wooden linings are partially removable, in order to enable an inspection of the inner painting of the vessel. The rest of the lining of the bulkheads and of the deck is constructed neatly and efficiently of well-seasoned wood.

The following crew spaces have been provided: 2 cabins for the dredging masters; 1 cabin for the engineer; 1 cabin for the assistant engineer; 1 space for the two firemen; 1 space for the mate; 1 space for the cook; 1 space for 5 sailors. There is in addition 1 kitchen, 1 pantry, 1 magazine, 2 toilets, 1 lampstore, 2 cable stores, etc. The cabins and crew spaces are adequately fitted with simple furniture. Ample admission of light and air is provided by means of scuttles and skylights. The living quarters are designed to accommodate a double crew.

The superstructures over the engine and boiler holds are

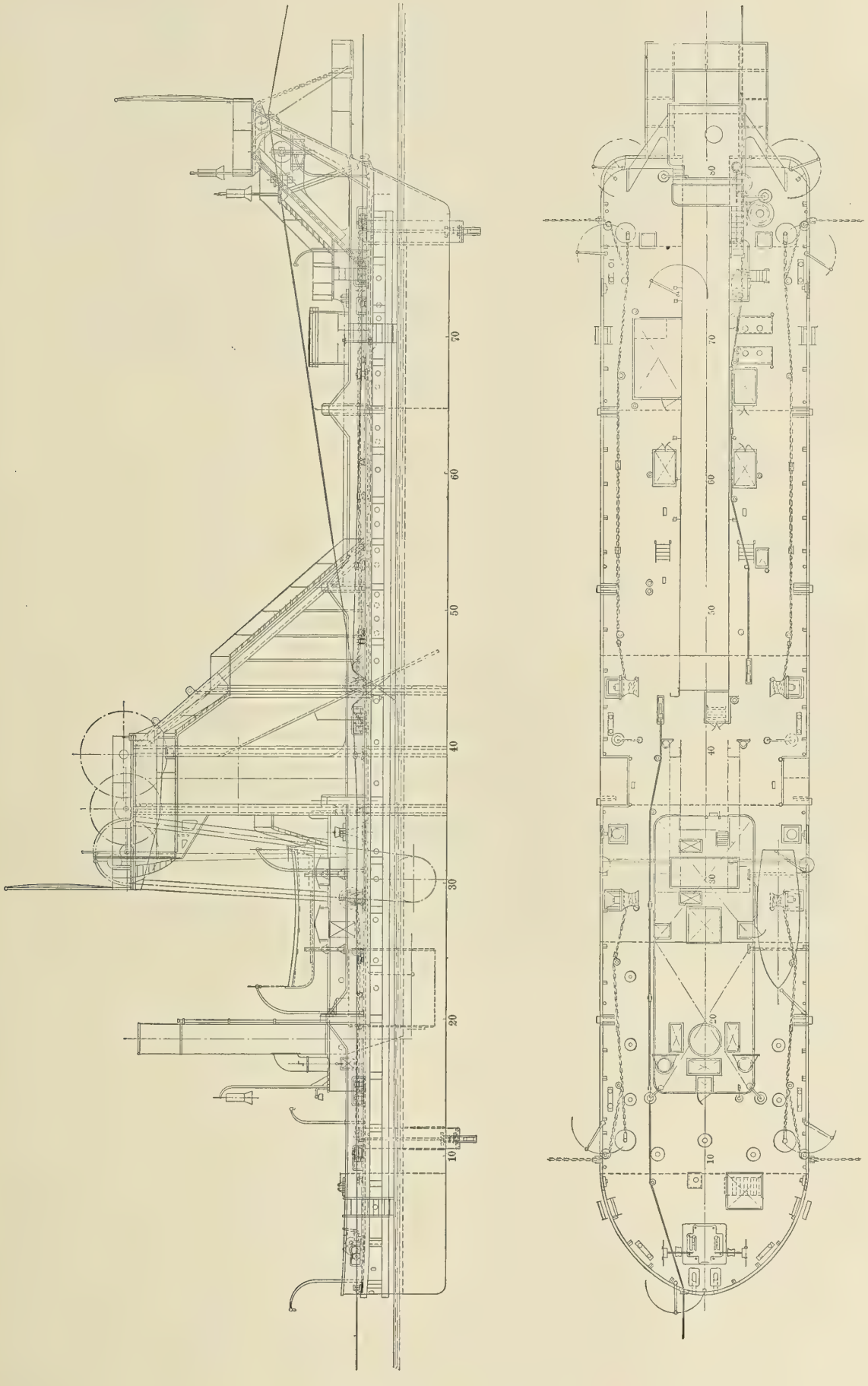


FIG. 2.—PLANS OF NEW DREDGERS FOR THE KAISER WILHELM CANAL.

constructed of plate and angle iron. The companions, deckhouse, enginehold, skylights, etc., are made of teak, and all the fittings are of brass. Furthermore, two scowl ventilators have been provided, one of which is equipped with a winch for raising the ashes, etc.

A bulwark, with a railing bar, is constructed on both sides of the vessel and along the well; scuppers in sufficient number have been provided. The whole inner bottom of the vessel down to the bilges is covered with a layer of Portland cement, covering the heads of the rivets.

In continuation of the sides of the well two intercostal keelsons are constructed, and two intercostal side-keelsons are fitted. The hull is divided into ten watertight compartments by nine transverse bulkheads.

MAIN FRAMING.

The main framing consists of a solid plate and angle bar structure. On it the gearing for driving the bucket chain and the suspension of the ladder are erected. It is well connected to the hull by columns of plate and angle bar, which are continued to the floors, and by the lateral box-shaped discharging chutes. For access to the different gearings stairs and platforms have been provided. The lateral movable chutes have, when let down, an inclination of 30 degrees to the horizontal. They can be swung in by electric winches so far that they do not project over the fender. In order to enable a more perfect distribution of the dredged materials the exterior part of these chutes is again hinged. The length of the movable chutes and the height of the axis above the water level have been chosen so that barges of 21½ feet breadth can easily be loaded. By maneuvering a balanced removable flap, supported on springs, the spoil is conveyed through the chute to the barges lying on either side of the dredger.

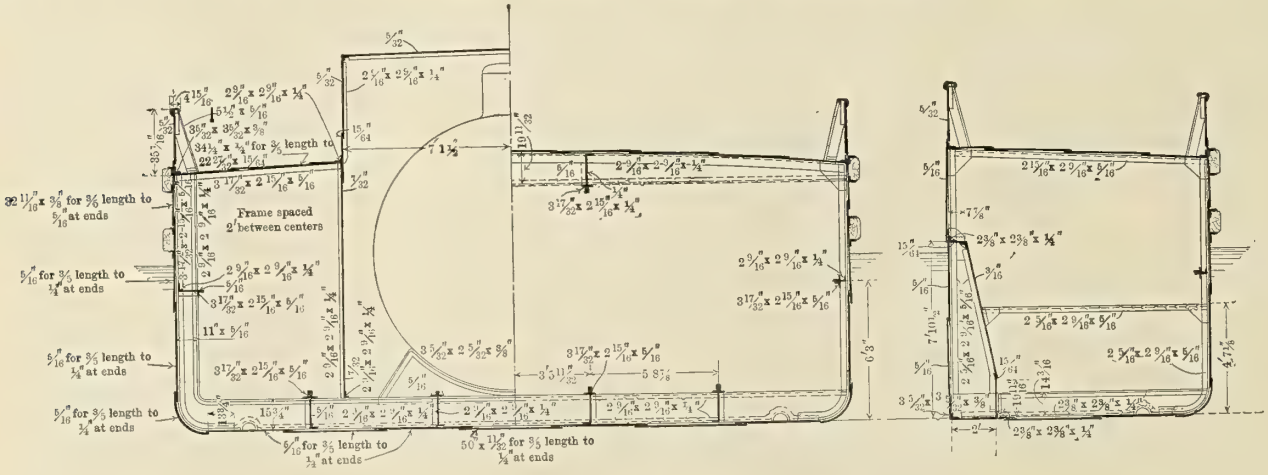


FIG. 3.—MIDSHIP SECTION SHOWING SCANTLINGS.

The lower part of the ladder is suspended by means of a steel-wire tackle to the fore-framing. This is a plate and angle bar structure, adequately solid to sustain the shocks and to connect the two halves of the vessel. It is provided with the necessary platforms, stairs, etc., and a swinging crane of 2 tons lifting capacity is erected on it for repairing and inspecting the buckets, the lower tumbler, etc. A platform for sounding is hinged to the fore-framing.

THE BUCKET LADDER.

The bucket ladder consists of two plate girders strengthened with angle bars and rider plates, adequately stiffened and trussed. The ladder is suspended to an axle at the main framing, independently of the tumbler shaft, and has thirteen pairs of cast steel rollers for supporting the bucket chain. Along the sides of the bucket ladder, and at the lower rider plates, screens are fitted in order to prevent the dirt splashing on the deck. The ladder is guided by rubbing plates bolted to its girders and flat bars on the sides of the well. At the upper end of the ladder a regulating device for neutralizing the slack in the chain is provided, by which the ladder can be lowered or raised for about 2 feet 6 inches. Both tumblers are pentagonal and of cast steel, with renewable steel wearing plates.

BUCKETS.

In the chain are forty-three buckets, the details of which are very simple. The back, bottom and links are in one piece of cast steel. Only the shell and the lips are of mild steel riveted to the backs. The lips are made of special steel for obviating excessive wear. The capacity of each bucket is 30.63 cubic feet, and the pitch of the chain is 2.62 feet, which gives the buckets a favorable shape.

The links connecting the buckets are of mild steel, and all have interchangeable bushes of special steel. The pins also are made of special steel, and are prevented from turning by stops on the bucket links.

MAIN ENGINES.

For driving the bucket chain a vertical compound engine of special solid construction with surface condensation has been provided. The air and circulating pumps are actuated directly from the cross-head of the main engine, which develops in normal working condition and at normal depth of dredging about 330 brake-horsepower. The engine is equipped with Marshall valve gear, with an expansion piston valve for the high-pressure cylinder, and a flat slide valve for the low-pressure cylinder. The admission of the steam to the high-pressure cylinder is controlled by a Stein patent governor. The principal dimensions are:

Diameter of high-pressure cylinder	13.44 inches
Diameter of low-pressure cylinder	22.40 "
Common stroke	16.00 "
Revolutions per minute	180

The condensing plant consists of a separate surface condenser, placed horizontally.

For driving the electric generator a vertical compound engine is directly coupled to the dynamo. It can work either condensing or exhausting into the atmosphere. It is controlled by a Stein patent crankshaft governor. The high-pressure cylinder is equipped with expansion valve gear, and the low-pressure cylinder with simple slide valve. The principal dimensions of the engine are:

Diameter of high-pressure cylinder	7.36 inches
Diameter of low-pressure cylinder	12.80 "
Common stroke	6.40 "
Revolutions per minute	350

The engine driving the dynamo for the electric light is a vertical, single-cylinder engine, directly coupled to the dynamo. This can also work non-condensing. It is controlled by a Stein patent crankshaft governor, and is equipped with a simple piston valve. The principal dimensions of the engine are:

Diameter of cylinder.....4.00 inches
Stroke .....4.48 "
Revolutions per minute..... 500

THE BOILER PLANT.

The main boiler is a horizontal, cylindrical return-flame boiler of the marine type, with a heating surface of 2,231 square feet and 162 pounds per square inch working pressure.

The grate surface and the heating surface are of such dimensions that ample steam can be produced for all engines at the same time. For supplying steam for electric lighting, steam heating and for the bilge pump a vertical donkey boiler of 108 square feet heating surface and 103 pounds per square inch working pressure is provided. The guaranteed coal consumption of first-class coal of at least 13,500 B.T.U.'s per pound, while developing normal power is 2.1 pounds per hour.

POWER TRANSMISSION TO THE UPPER TUMBLER SHAFT.

The power of the main steam engine is transmitted to the upper tumbler shaft by means of a leathern belt and a double set of toothed gearing (helical wheels). Moreover, a hydraulic friction coupling is interposed, which enables the stopping of the bucket chain almost instantly, independently of the main engine. In order to prevent the chain with a full bucket from running back an efficient brake is provided.

WINCHES.

All winches for the maneuvering of the dredger while working are electrically driven independently from each other. The winches for the lateral movement of the dredger and those for hauling the barges are installed on the deck, as the drawing shows. All winches can turn in both a forward and backward direction, and are controlled by one man at the handles. The lateral winches are designed with horizontal drums. The motors driving the latter winches and the gearing are erected on the bed plates and situated under the deck.

The ladder is raised and let down by a winch erected at the fore-framing. *It is driven by a motor, well protected against the weather, and placed on deck.* The power of this motor is transmitted by means of spur and worm gearing to a wire drum.

On the fore-deck a capstan is fitted driven by the motor of the ladder-raising winch.

The *following electrically-driven winches* are provided: Two fore lateral winches, 2 after lateral winches, 1 winch for the fore hawser, 1 winch for the after hawser, 2 winches for hauling barges, 2 winches for the chutes, 1 capstan, 1 winch for the crane.

The winch for the sounding platform is driven by hand, and the windlass by steam. The lateral movement of the dredger is effected by means of chains, which are either guided through tubes at least 11 feet 6 inches below the water level, or run over guide rollers placed on deck. The forward and backward movement of the vessel is effected by means of steel wire hawsers. Also the bucket ladder is suspended by steel wire hawsers. On deck the necessary guide-rollers, hawse-pipes for guiding the chains and hawsers, and also hooring bitts, boat cranes, anchor cranes, and so on, are fitted.

HEATING AND LIGHTING.

The direct-connected dynamo engine supplies ample current for the necessary electric arc lamps and incandescent lights. Six arc lamps are provided for lighting on the deck, and for internal illumination incandescent lights are fitted.

The heating of the cabins, engineroom and winch hold is effected by steam, and in the crew quarters iron stoves are fitted.

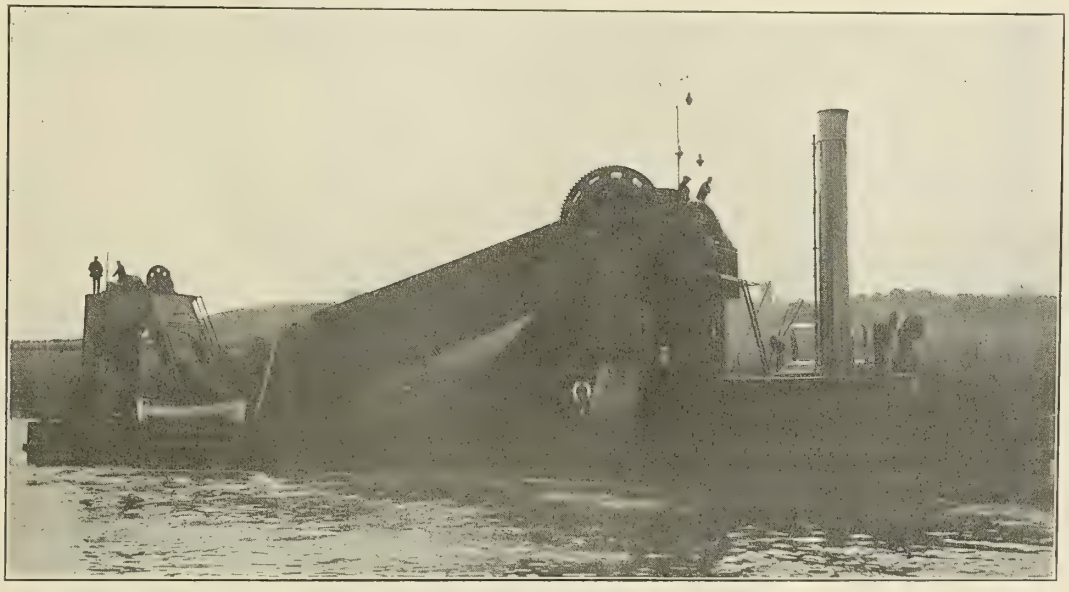


FIG. 1.—THE ROCK-LIFTING DREDGER VISCOUNT RIDLEY.

A ROCK-LIFTING DREDGER.

The deepening of the harbor and entrance channel at Blyth, so as to have 24 feet at low water or 39 feet at high water of spring tides, involves the removal of about 500,000 cubic yards of rock. For dredging this broken rock the Blyth Harbor Commissioners have recently introduced the powerful dredger *Viscount Ridley*, which has been built by Fleming & Ferguson, Ltd., of the Phœnix Works, Paisley. This vessel has a length of 136 feet, a breadth of 30 feet, and a depth molded of 11 feet 6 inches. She is specially constructed with heavy scantlings so as to withstand the abnormal strains of rock dredging, and is capable of lifting rock at depths varying down to 45 feet below water-line. The engines for driving the main gear are coupled direct to the gear shaft, and are supplied with steam from one large cylindrical return-tube boiler. The shaft for driving the bucket chain is driven through cast steel spur and bevel gear, the teeth all being machine cut. These, together with the shaft, brackets and framing, have a large

FIG. 2.—BOULDERS DREDGED FROM THE HARBOR.

margin of strength over the power developed by the engines, so that in the event of the buckets getting such a hold on the rock as to stop the gear, the risks of a breakdown are largely reduced.

The bucket ladder is constructed of mild H section girders, 96 feet in length between centers and 6 feet deep at center,

FIG. 3.—DREDGER AND HOPPER IN BLYTH HARBOR.

and is strongly braced, while the chain of buckets is of special design, the bucket rims being reinforced by hard steel cutting lips. Both the hull and machinery of the vessel were constructed under Lloyd's special survey, and the boat is fitted with a complete installation of auxiliary machinery. To maneuver the vessel, three specially powerful dredger winches are fitted on deck. Independent steam engines are provided

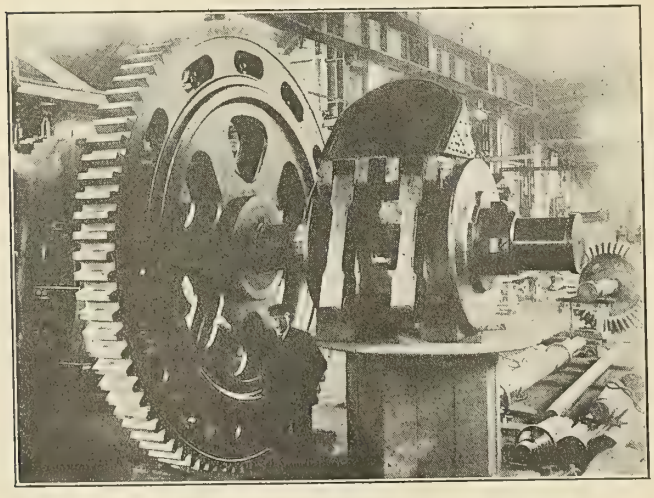


FIG. 4.—TOP TUMBLER AND MAIN DRIVING SPUR WHEEL.

FIG. 5.—BOULDER COMING DOWN THE DREDGER CHUTE.

for hoisting and lowering the bucket ladder and shoots, and there is also an electric installation for lighting the vessel for night working.

The rock in Blyth harbor consists of very hard sandstone intermixed with veins of metamorphic rock, and large numbers of boulders are also met with. Fig. 2 shows a number of these boulders taken out of the buckets in the space of three hours. As the removal of the boulders from the buckets entails a loss of time, it was decided to allow them to go down the shoots into the hopper barge alongside, and to prevent them from damaging the barges strong channels are fixed to the points of the shoots in order to minimize the impact of the stones striking the hopper beams and chains of the barge. This arrangement has proved very successful, and stones weighing over a ton regularly pass down the shoots into the barges. Fig. 5 shows one of these boulders, which, owing to its shape, came down the shoots at a great velocity, and, striking the guard bar at the point of the shoot, traveled over the hopper on to the deck of the barge and then into the river. The guarantee undertaken by Fleming & Ferguson, Ltd., was to

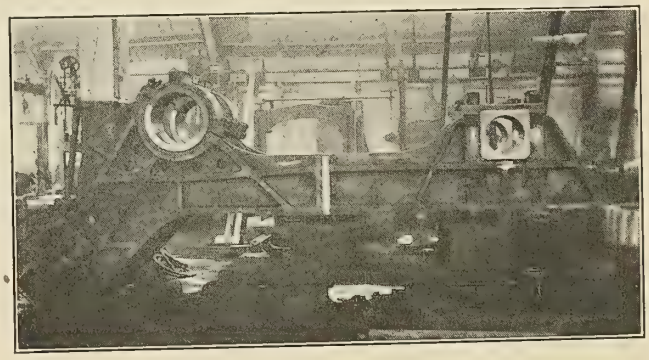


FIG. 6.—MAIN GEAR TOP BRACKETS.

raise 200 tons of rock per hour, and this was exceeded during the three days' consecutive trials just completed. The maximum rate of dredging obtained was at the rate of 273 tons per hour.

We are enabled to give a series of engravings and some drawings of this interesting vessel. Fig. 1 shows her leaving the builders' yard. Fig. 3 gives a view of the dredger with one of the hoppers lying alongside in Blyth harbor. Fig. 4 is reproduced from a photograph taken in the shops, and shows the top tumbler and shaft with a bucket and pair of links, and the main driving spur wheel; it gives an idea as to the proportions of the gear on this vessel. Fig. 6 shows the main gear top brackets in course of construction in the shops, and

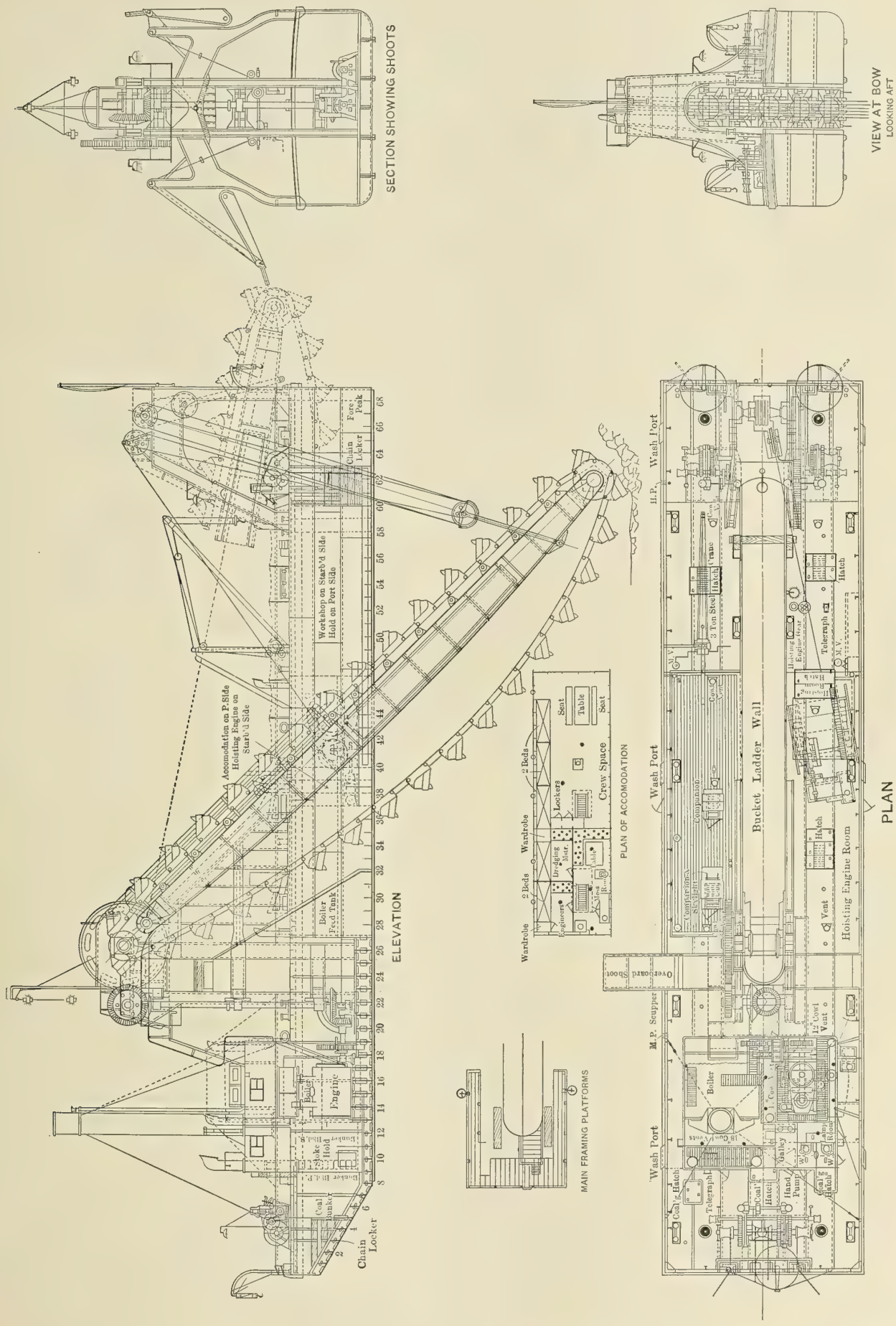


FIG. 7.—THE HOPPER DREDGER VISCOUNT RIDLEY

Fig. 7 gives detailed drawings. The vessel was built to the instructions and requirements of Messrs. J. Watt Sandeman & Son, Newcastle-upon-Tyne, the engineers for the Blyth Harbor Commissioners, and the trials were carried out under their supervision and that of Mr. G. D. McGlashan, the resident engineer at Blyth.—*The Engineer.*

AN ELECTRICALLY-OPERATED SUCTION DREDGER

BY WILLIAM T. DONNELLY.*

In Figs. 1 and 2 are shown designs for a new type of electrically-driven suction dredger which are the result of a recent thorough investigation of this problem, and which represent the most modern application of electricity to this work. The use of electricity in operating marine machinery of this class is not new. Perhaps the most notable example was the Bates electric-driven hydraulic dredger, previously illustrated and described in the May, 1909, issue of INTERNATIONAL MARINE ENGINEERING. A more recent example is illustrated in an article on "Electricity in Dredging on Puget Sound," published in the March, 1910, issue of *The Electric Journal,* which describes a smaller dredge operated by current supplied from a distant water-power generating plant. In both of these examples, however, the use of electricity was confined to the replacing of steam power in the operation of well-known types of dredging apparatus.

In the present study it is believed that a considerable advance has been made upon this practice in so modifying and designing the dredging apparatus as to take full advantage of the flexibility of electricity as a power device, and to thereby greatly simplify the installation as a whole.

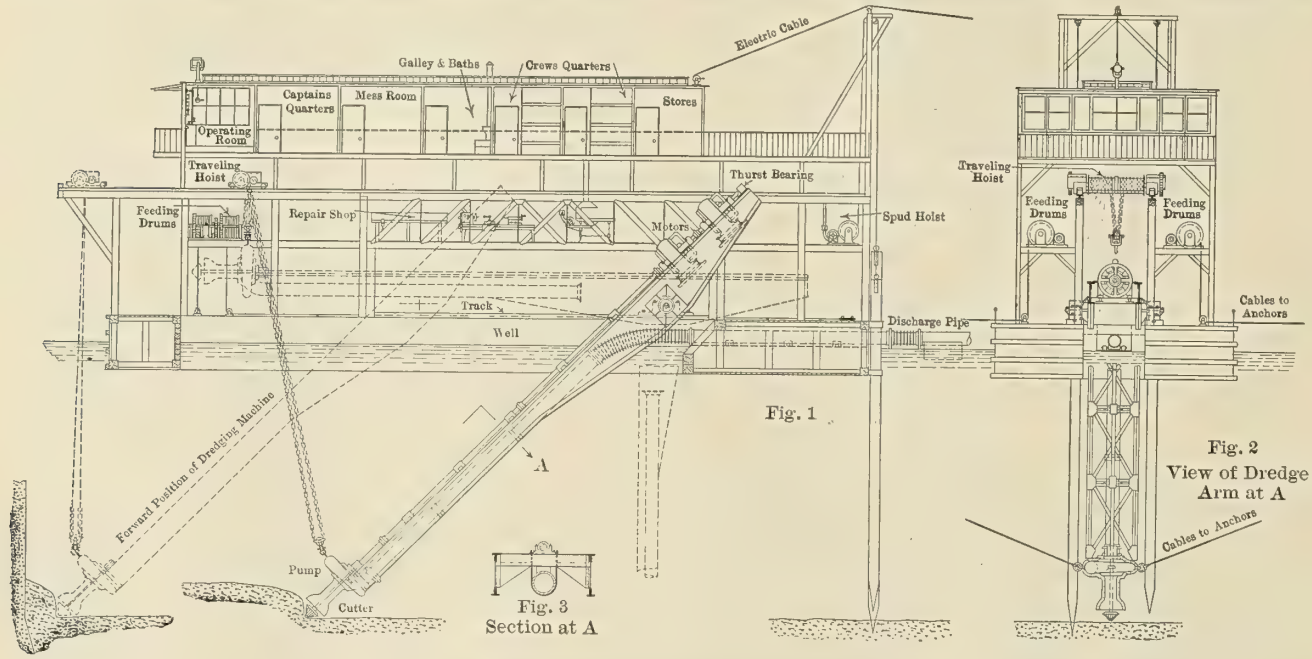
By referring to Fig. 1 and 2, it will be seen that the dredger scow or pontoon is of the usual rectangular construction of dimensions and displacement to correspond to the weight of apparatus which, in the electrically-operated dredge, will be of much less weight, owing to the absence of boilers, water and fuel. It will be understood that the design contemplates the operation of these dredges either from an outside source of electric current or from a floating central station of sufficient capacity to supply current to several dredges. The plans, as shown, are for a 20-inch suction dredge, which would require approximately 500 electric horsepower for operating through a discharge line of moderate length.

By referring to Fig. 1, it will be seen that the principal structural modification is to place the pump at the lower end of the ladder, thus making it submerged with a suction only a few feet long. A second modification consists in placing the cutter, which has heretofore been operated by a separate shaft and motor, upon the extended pump shaft. The much higher speed of the cutter makes it possible to decrease its diameter.

It will be seen that the ladder is extended beyond the fulcrum on the barge, and carries two electric motors mounted so as to act as a partial counter-balance for the weight of the pump and ladder, and that at the upper end of the ladder beyond the motors there is provided a powerful thrust bearing. The ladder and trunnions are made very heavy, the trunnions being 24 inches in diameter, of heavy ribbed steel casting mounted in large pedestals, which are secured on heavy cast steel plates or shoes extending along each side of the well.

An inspection of Fig. 2 shows that the suction ladder is raised and lowered by a standard electric crane, having a track running the entire length of the barge, with an overhang at the bow, making it possible to pick up heavy parts from a barge or other vessel at that point. By raising the ladder to a horizontal position, as shown by the dotted lines, and blocking underneath it, it is possible to use the electric crane for handling any part of the equipment for removal or repair. It is also possible, by proper arrangement of the bridle chain, to lift the entire ladder when in a lowered position, and by slacking off on the pillow blocks, move the ladder, pump and motors toward the bow of the pontoon, so as to enable the cutter to work up against a bulkhead or close to a pier.

It will be noticed that the delivery pipe runs below the ladder from the pump and through a gap at the stern of the dredge to the small pontoons, and that it is free to advance with the ladder when it is moved to the forward position in the pontoon. The design of the pump contemplates the division of the casing along the center line, with all bearings secured to the lower half so that when the ladder is lifted to the horizontal position and blocked up in place, the electric crane can



NEW TYPE OF SUCTION OPERATED BY ELECTRICITY.

* Consulting Engineer, 135 Broadway, New York City.

pick off the upper half of the casing, when access can be had to the interior for examination and quick repair.

From Fig. 2 it will be noticed that it is intended to operate the dredge by a lateral swinging motion, brought about by drift lines attached to the sides of the pump casing and running to anchors and back to a windlass operated by motor on board the dredge. The advance of the dredge will be accomplished by means of a pair of spuds in the usual manner.

Reference to the detailed sketch, Fig. 3, will show the manner of suspending the pipe line under the ladder. This makes it possible to readily remove sections of pipe when the ladder is raised.

The electric power equipment for the pump and cutter will consist of two motors operating on the same shaft, to be operated in series or parallel, as the length of suction pipe and the resulting power and speed may require. It will be seen that ample provision is made for crews' quarters and tools for prompt repair to small parts.

With the ever-increasing amount of suction dredging to be done, it is believed that the time has arrived to reduce the equipment of the suction dredge proper to the simplest practical construction, and to operate a number of them from one source of power, either from a floating generating plant specially designed for the economic production of power exclusively, or from an outside source of electric energy which can be depended upon for current at all times. The experience of all operators of dredging machinery is to the effect that profits are to be depended upon if the machinery can be kept constantly at work, and that failures and loss are occasioned by interruptions due to a breakdown in some part of the too complicated apparatus.

A careful review of the construction under this system shows that four dredges of this type with one power plant sufficient to supply power for all, would cost less than two complete dredges each having an entirely separate equipment of engines and boilers, and that they could be operated for less money. It should be further pointed out that the power-generating plant and the vessel containing it would be available for other purposes when not in use furnishing power to the dredges, while a dredge as such can be used for no other purpose when not engaged in dredging.

Figs. 4 and 5 are diagrammatic views, showing how a number of these dredges could be grouped to work to advantage; the plan view, Fig. 5, showing how they would be arranged for a wide channel, and Fig. 4, showing how they could proceed one after the other, deepening the channel.

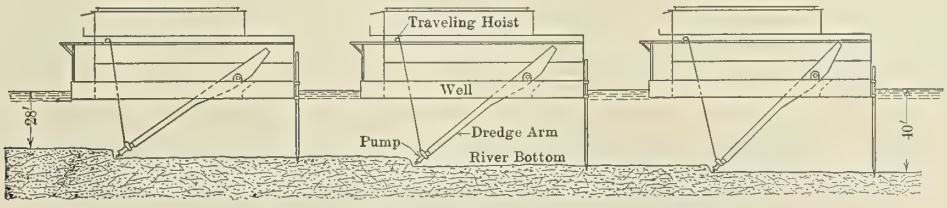


FIG. 4.—ARRANGEMENT OF DREDGES FOR DEEPENING A CHANNEL.

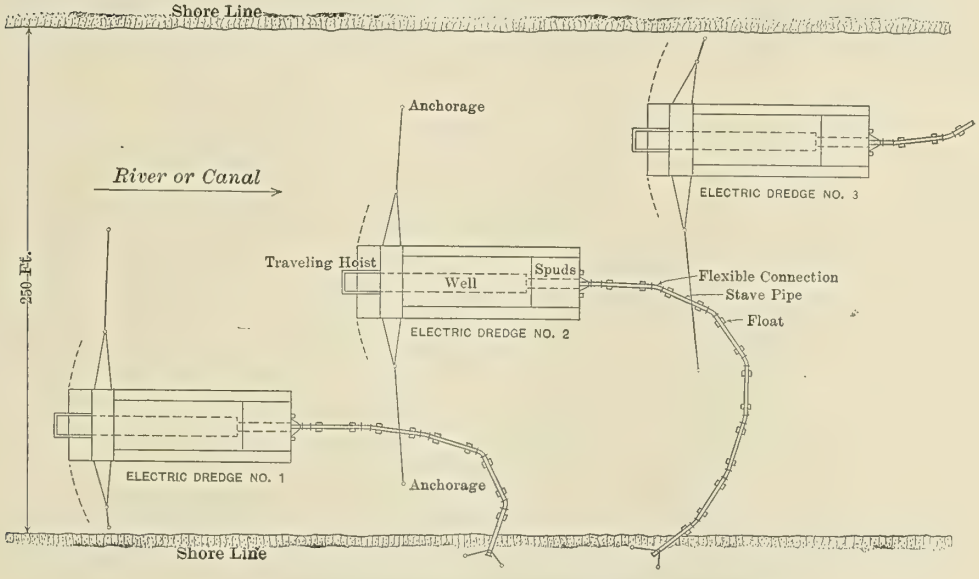


FIG. 5.—ARRANGEMENT OF DREDGES FOR WIDENING A CHANNEL.

This general system for the use of electricity is an outgrowth and extension of the writer's study of "Modern Marine Transportation," as published in the January and February, 1908, issues of International Marine Engineering.

Electric-driven suction dredges are being used with success on the Pacific Coast. In dredges of this type, built by the United Iron Works, Oakland, Cal., the electric current is supplied from an outside source, and is carried on board by means of a three-conductor cable, which is incased in 2-inch hose. The hose is put on in lengths of 50 feet, and has a special rubber jacket over each joint. The joint is thoroughly vulcanized, making it watertight. Where there is a sand bottom the cable is laid on the bottom of the channel; but where there is soft mud the cable often buries itself, and it is difficult to remove it, hence it is carried on a pontoon line.

MAMMOTH CLAY CUTTING SUCTION RECLAMATION DREDGERS.

A very powerful *clay* cutting suction discharging dredger, constructed in May, 1908, by Wm. Simons & Company, Ltd., Renfrew, Scotland, to the order of the Rangoon Port Trust, has been giving some remarkable results in service at Rangoon. This dredge, which is known as the *Pelican,* is one of the largest suction dredgers in the world. She is of the twin-screw type, 208 feet in length, 36 feet beam, with a draft of

FIG. 1.—CLAY-CUTTING SUCTION DISCHARGING DREDGER PELICAN.

10 feet 6 inches. The speed under ordinary conditions is 9 knots. The dredger is equipped with two sets of pumping engines, and is fitted with a suction pipe for dredging from a depth of 35 feet, and can deliver 80,000 cubic feet of sand and silt per hour through a pipe line 3,000 feet in length. There are special features in the design of the pipe line, which call for attention. The line is carried on a series of pontoons spaced 50 feet apart, center to center. The novelty in the pipe line is in the joint, employed between each pair of

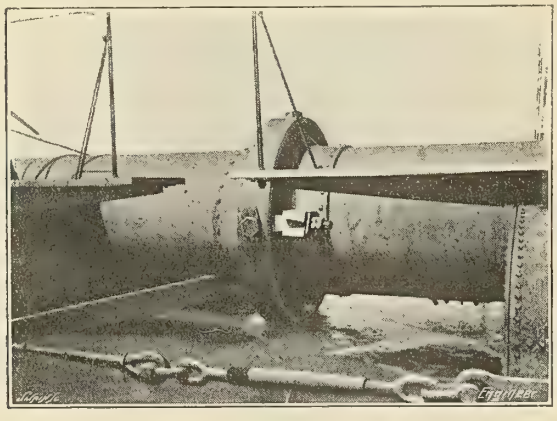


FIG. 2.—PIPE-LINE JOINT.

pontoons, to permit of lateral and vertical movement in the line of pipe. This joint is illustrated in Fig. 2. Formerly either rubber or leather jointing was employed for pipe lines of this character, but owing to the heavy nature of the service such joints had a very short life, and the necessity for frequent removal was constantly hanging up the plant. In the present instance, therefore, use has been made of a ball-and-socket joint of cast steel, the design adopted being claimed to give maximum freedom of movement in every direction while providing an absolutely watertight joint; special packing being employed for this purpose on the outer edge of the joint. This ball-and-socket design was first employed by Simons & Company, in a pipe line working at Calcutta, and the satisfactory behavior of the joint in service there led to its adoption for the pipe line now in service at Rangoon.

The main purpose for which the *Pelican* was specially designed and constructed was for the work in the Hastings Shoal, below Rangoon, the object being to deepen the main channel up to the port, so that the largest steamers might gain access to the wharves without discharging part of their cargo lower down the river, as has been necessary hitherto. This preliminary dredging work, now practically completed, will enable vessels drawing up to 28 feet of water to get up to Rangoon at all stages of the tide without unloading. The next work on which the dredger is to be employed will be in cutting through the Chalon Shoal above Rangoon.

PERFORMANCE OF THE JINGA AND KALU.

In our annual dredger issue for 1909 we gave a brief description of the reclamation dredgers *Jinga* and *Kalu,* built by Wm. Simons & Company, Ltd., for the Bombay Trust. These dredgers have now been in service over a year, and we are able to present a brief report of the work which they have done.

The total area to be reclaimed is 622 acres, of which 554 acres will be land actually retrieved from the sea, while the remainder is low-lying land, to be raised to a higher level. The reclamation will add about 6 percent to the area of Bombay, and by providing ground for the erection of depots for the seed, cotton and other trades will set free valuable residential building sites.

The *Jinga* began dredging late in the month of December, 1908, and the *Kalu* early in January, 1909. Since then both dredgers have been constantly employed in dredging and discharging stiff blue clay. A spiral rotary cutter of special form and of great strength is provided at the suction nozzle for breaking up the clay or other hard material. The pumping outfit of each dredger is claimed to be the largest and most powerful afloat, and consists of centrifugal pumps driven directly from triple expansion engines. The dredgers were each guaranteed to dredge 2,000 cubic yards of spoil per hour, and to discharge same to a distance of 4,500 feet through a floating pipe line. But in actual work the results obtained were greatly in excess of this guarantee. So far the best work done by either dredger is 2,700 cubic yards

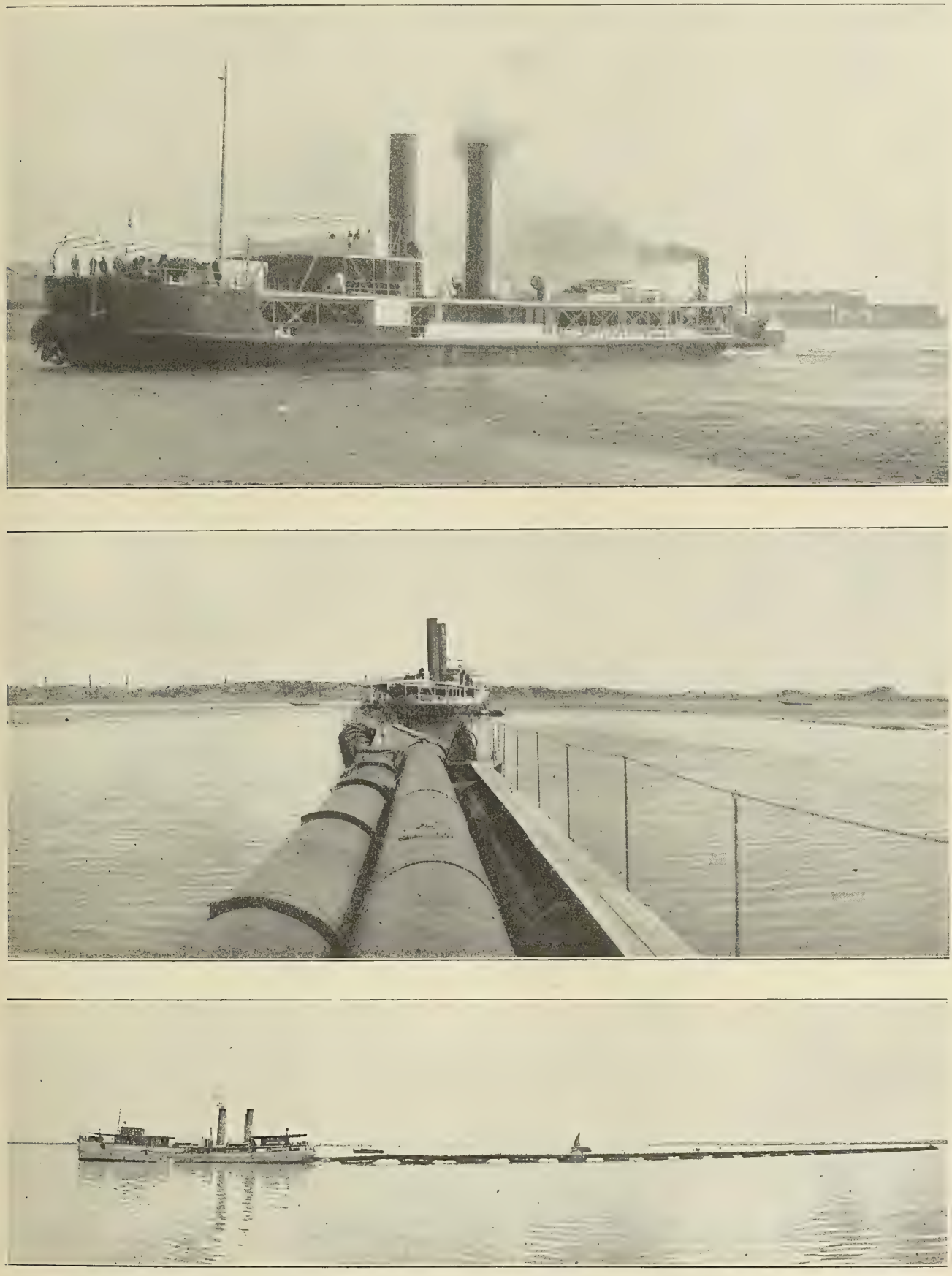


FIG. 3.—VIEWS OF SUCTION DISCHARGING DREDGERS AND PIPE LINES FOR THE BOMBAY TRUST.

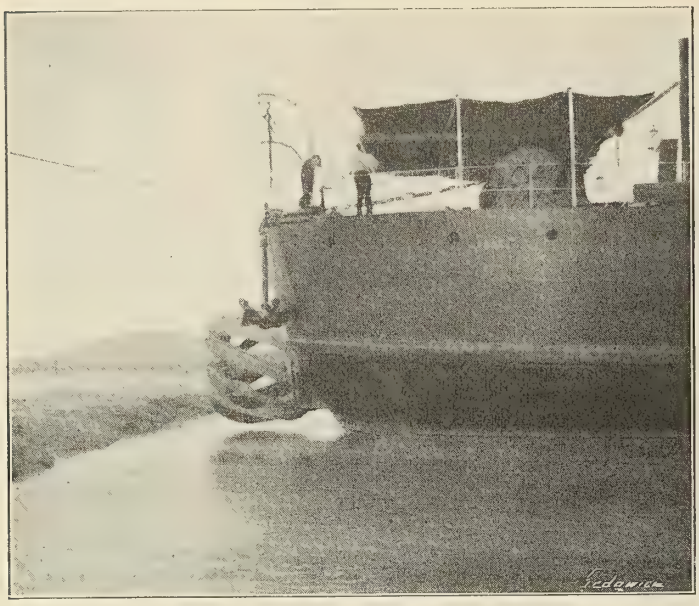


FIG. 4.—CUTTER.

per hour dredged and discharged; or in other words, results have been obtained which are 35 percent in excess of the guaranteed capacity.

The *Times* of India in instituting a comparison between the old-fashioned method of reclaiming by means of Coolie labor and bullock carts (when 5,000 bullock carts full per day was considered excellent work) says, "that the dredger will do nearly as much work per hour as the bullock carts will per day."

We reproduce a photograph showing the *Jinga* and a portion of its pipe line in a channel cut by the dredger itself. It may not be without interest to state that this dredger opened up a channel through land at some places above water level, 300 feet wide at water level by 30 feet deep by 3,000 feet in length in 250 hours' actual dredging time. Which is to say that the two dredgers working together could open a navigable channel equal in width and depth to the Suez Canal at a rate of 1 mile every 220 hours of actual dredging.

To illustrate the great volume of material discharged through the pipe line, photographs of the discharge at the end of the pipe line are shown in Fig. 5. Views are also shown of the dredger, and its line of floating discharge pipes and of the discharged material at end of pipe line.

FIG. 5.—DISCHARGE AT THE END OF THE PIPE LINE.

On several occasions large pieces of stone and flint, weighing upwards of three quarters of a hundredweight, were discharged by the *Jinga* and *Kalu*. There is every reason to believe that many much larger and heavier stones were dealt with by the dredgers, but which, when discharged at the end of the pipe line, were covered up by the rush of clay, and thus could not be recovered readily. This belief is more than strengthened by the fact that one of the dredgers discharged a boulder which weighed more than 400 pounds.

LARGE CALIFORNIA GOLD DREDGES.

BY GEORGE BOWERS.

Some of the largest gold dredges ever put into operation in any part of the gold dredging world are installed on the Folsom Division of the Natomas Consolidated of California. These dredges are of two sizes, being equipped with bucket-lines of the close-connected type, the capacity of each bucket being 8½ cubic feet and 13½ cubic feet, respectively. The depth of the ground handled by these dredges ranges from 20 feet to 75 feet.

The ground being dredged is of two different kinds, and includes the well-known Rebel Hill. The gravel channel traversing this hill is deeper and more compact than any other in the district. It ranges in depth from 50 to 75 feet. and is virtually cemented for the first 6 or 8 feet, and is very compact for the next 25 or 30 feet, while the lower strata is loose.

To dredge this deposit, without constant blasting, was long considered economically impossible, and it was also believed impracticable to construct a dredge strong enough to dig this deep cemented gravel. However, the problem was successfully solved by Mr. R. G. Hanford, manager of the Folsom Development Company, and there are now three dredges having 8½ cubic feet buckets working successfully in this hard ground. These dredges work against a bank ranging from 20 to 27 feet high above the waterline, which is broken down by means of hydraulic monitors situated on the bow of the dredges.

The dredges working this ground were constructed by the Western Engineering & Construction Company, of San Francisco, Cal., and are equipped with machinery built by the Bucyrus Company, South Milwaukee, Wis. The latest of these is Folsom No. 6, which handles 165,000 cubic yards of gravel per month. The hull is 120 feet long, 46 feet 6 inches wide on the waterline, and 10 feet 3 inches deep, having 4-inch planking on the deck, sides and bottom; the stern planks are 8 inches thick, and the bow and well-hole planks are 6 inches thick. There are 86 buckets in the line, having a net capacity each of 9 cubic feet. The total weight of the line is 263,000 pounds. The ladder is of the plate-girder type. The revolving screen is 7 feet diameter by 36 feet long. The tailing stacker is of the lattice girder type, and is equipped with a 38-inch Robins belt conveyor, 142 feet centers. The steel spud is 34 inches by 54 inches by 75 feet long, and weighs 76,000 pounds. The wood spud is 34 inches by 54 inches by 76 feet long, and is one of the largest single sticks of timber ever handled on the Pacific Coast.

The gold-saving tables are of the double bank type, and are constructed of steel, and have 3,000 square feet of riffle area. The upper tail sluices extend approximately 38 feet behind the stern of the dredge. The lower tail sluices extend approximately 20 feet behind the stern of the dredge.

The double bank of tables has accomplished two vital objects: First, materially increasing the gold-saving area, and, second, by the use of four tail sluices of different lengths the sand and fine gravel is more evenly distributed behind the

dredge, thereby making it possible to discard the use of a sand pump, which has always been a source of trouble and expense.

The high-pressure water used inside the revolving screen for disintegrating the material is supplied by one 12-inch centrifugal pump, direct connected to a 100-horsepower motor. The water supply for the tables is supplied by a 12-inch centrifugal pump, direct connected to a 50-horsepower motor, and the dump hopper sprays, for washing the buckets, are supplied by a two-step centrifugal pump, direct connected to a 30-horsepower motor.

There are two hydraulic monitors, fitted with 3-inch nozzles, which are located on the port and starboard bows of the dredge. These monitors are supplied by one 12-inch centrifugal pump, direct connected to two 150-horsepower motors, delivering water against a head of 150 feet, and can be operated either together or separately.

The aggregate capacity of all motors installed on the dredge is 790 horsepower. The total weight of the machinery, including hull complete, is 2,395,235 pounds.

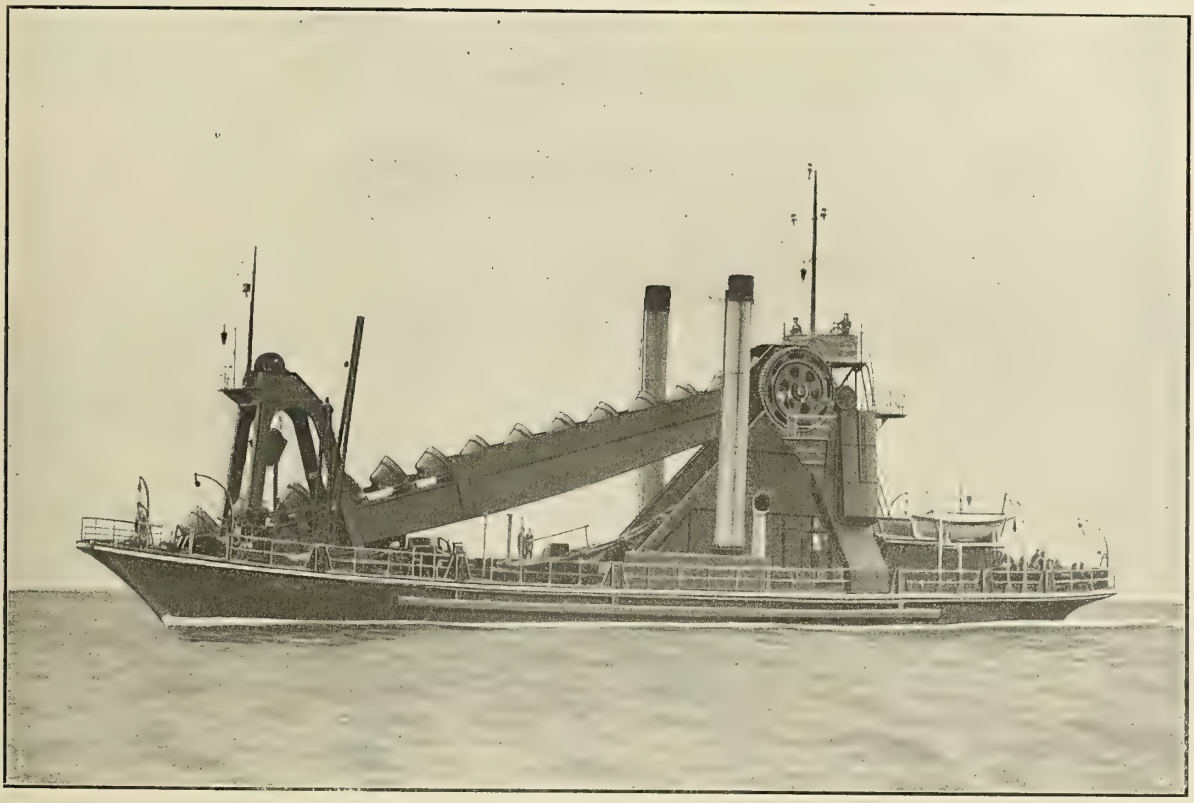
The successful operation of Folsom No. 6 demonstrated clearly that it was not impossible to dredge the compact gravel on Rebel Hill with large machines. The Natomas Consolidated, of California, is now building a 13½-cubic foot bucket dredge to handle this deep ground, which will average from 60 to 65 feet below waterline. The dredge will be placed in commission during the present year.

The 13½-foot bucket dredges now in operation upon this property are working in loose and sandy ground. They are equipped with extra large shaking screens, double-bank type of gold-saving tables, and dig 20 feet below the water level. Each dredge has a capacity of 250,000 cubic yards per month. The aggregate horsepower of all motors on the dredge is 605. The problem of clearing the dredged area, covered with great piles of dredge tailing, ranging from 30 to 45 feet high, and returning the ground to a farmable condition, has been successfully solved.

A LARGE BUCKET DREDGER.

The illustration shows the self-propelling barge-loading bucket dredger *Crewe* for the London & North Western Railway Company for service at Garston Dock, Liverpool, by Ferguson Bros., Port Glasgow. The dredger, which was launched complete with machinery aboard and steam up, is the largest and most powerful bucket dredger owned by the company. She is of the bow-well, center-bucket ladder type, and is capable of raising 900 tons per hour.

The vessel is built to Lloyd's highest class; side shoots are arranged for discharging the dredged material over either side into hopper barges, the lifting and lowering of each shoot being worked by an independent steam engine. The main engines, which are employed for either propelling or driving the dredging gear, consist of one set of triple-expansion surface condensing engines of 700 horsepower. There are two speeds of gearing to enable the buckets to be worked at different speeds, according to the nature of material being dredged. Two large multi-tubular boilers supply steam to the various engines. The lifting and lowering of the bucket frame is controlled by an independent double-cylinder engine, working the latest improved type of hoisting gear. The accommodation for the officers and crew is fitted forward, and is commodious and handsomely finished. Electric light is fitted throughout.



SELF-PROPELLING, BARGE-LOADING BUCKET DREDGER CREWE.

When the launch of the cruiser Minnesota was lost in Hampton Roads with several midshipmen on board a year or more ago, the fatality was attributed to the fact that the canvas covering used on the metal frame work as protection against the weather was so fastened that it could not be quickly released, and the men were thus hopeless imprisoned in the sinking boat. This fact has led the naval constructors to work out a design for a launch canopy which can be easily adjusted and folded out of the way in case of danger.

GOLD DREDGING IN CALIFORNIA.

The first successful gold dredge put in operation in this country was in 1897 by the Risdon Iron Works, of San Francisco. This dredge was practically a New Zealand machine (in which country the gold dredging industry had been growing steadily for the previous ten years). Since the date of the first successful gold dredge in this country the growth of the industry has been very rapid. It is safe to say, in California, there are over seventy machines in operation, and the annual returns in gold are between seven and eight million dollars.

The first machine to be installed was one having buckets of 3¼ cubic feet capacity, with a monthly capacity of between 35,000 and 40,000 cubic yards. The size of machine and capacity have steadily increased until the buckets have a capacity of 13 cubic feet, and the monthly yardarge will exceed the 250,000-yard mark.

While the machines themselves have been greatly improved in size, strength and design, at the same time the very latest up-to-date machine of to-day combines and utilizes exactly the same principle of the first successful machine in 1897. The machine consists of a pontoon provided with a long well for a little over half of its length, in which well is lowered a steel ladder, hinged at the upper end. This ladder carries the chain of digging buckets. The buckets discharge the gravel into a revolving screen, which screen separates the fine material and gold from the coarse. To aid the separation, water at a high pressure is discharged from a pipe in the revolving screen on to the material, and the high efficency of this simple device is remarkable. While it will not save all the gold, at the same time it is safe to assume that 95 percent of the gold is saved when this method of procedure is followed. The perforations in the revolving screen average ⅜ inch in diameter, and nothing over that size passes onto the tables. The balance of the material is carried away by means of a stacker and stacked at the stern of the dredge. Necessary winches and driving mechanism, of course, together with pumps, make up the complete machine.

With the growth of this industry a great number of experiments have been tried, but, whenever the experimenters have departed from the principle of this machine, they have not met success or only partial success. Of course, the general design of the machines has been greatly improved and simplified. Manganese steel has been introduced for all tumbler plates, bucket links, bucket lips, screen plates, etc., and, in fact, all parts subject to wear are now made of this material, the cost of which is about twice that of the other, but the wearing value is easily five or six times greater than the cheaper material.

With the introduction of the very large machines, ground that only contained gold values between 6 and 7 cents per cubic yard, and was hitherto considered worthless, is now being successfully handled and large profits made with the new large modern machines.

7-CUBIC-FOOT RISDON GOLD DREDGE, CAPABLE OF HANDLING 85,000 CUBIC YARDS PER MONTH.

PORTABLE DREDGES.

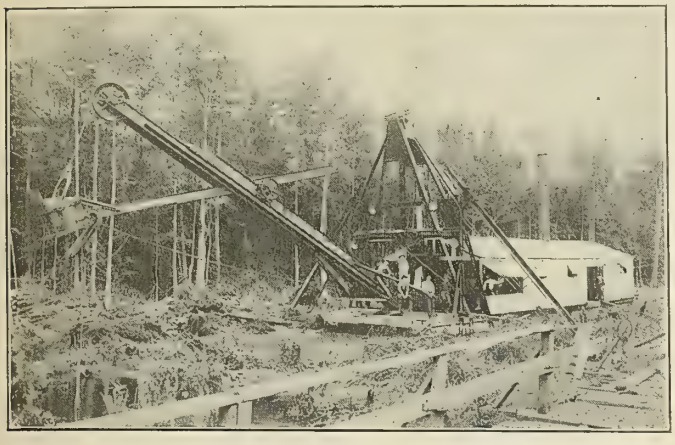
Dipper dredges might, for discussion, be divided into two distinct classes with reference to the conditions under which they are designed to work, viz.: those of a permanent nature employed in river or harbor work, and which are towed from place to place, and where it is necessary to use vertical or upright spuds; and those which are more of a portable nature, permitting of being dismantled and transported from job to job, and which are used in the construction of drainage ditches and canals, where the banks of the channel are available for anchorage, and where what are termed bank spuds are employed.

This latter type, owing to the wonderful impetus to the reclamation of swamp lands in the last few years by systematic drainage, has been developed to a high degree of efficiency. We illustrate herewith a modern dredge of this type known as the American steel dredge, manufactured by the American Steel Dredge Company, of Fort Wayne, Ind.

In this dredge the superstructure, including the boom, "A" frame, dipper handle, spud frame and spuds are constructed of steel, only standard commercial shapes being employed, with the result that the maximum stiffness and rigidity are combined with the minimum of weight, and the ability of being conveniently dismantled and transported from one place to another. This feature is further exemplified by the hull being constructed in sections on entirely new lines with the same purpose in view.

The dipper is operated by a single line of cable running

direct to the hoisting drum, over but one sheave of large diameter at the point of the boom, thus reducing internal friction, offering conditions for the longest life of the cable and smooth and noiseless operation, aside from increased reach. This arrangement of the cable is accomplished by the unique design of compound-geared hoisting engines, all gearing for



PORTABLE DREDGER WORKING IN SWAMP LAND.

which, together with that of the independent reversible swinging engines, is of steel with machine-cut teeth.

The bank spuds are automatic in their action, being positively and automatically locked in any position, and it is claimed are exceptionally quick and effective in their operation.

These dredges are distinctive by having no welds, rods or turn-buckles in their construction. They are built in a number of sizes up to 2½ yards.

Comparative Cost of Operation of Cruising Launches of the Revenue Cutter Service Using Coal and Gasoline (Petrol).

The revenue launch *Guard* is a single-screw wooden launch of 30 tons displacement, being 65 feet long, 9 feet 6 inches beam and 5 feet 3 inches depth, fitted with a compound engine with cylinders 7 inches and 15 inches diameter and 10 inches stroke, and is stationed on Puget Sound, Washington. The revenue launch *Guide* is a twin-screw wooden launch of 32 tons displacement, being 70 feet long, 13 feet beam and 7 feet 11 inches depth, fitted with two 60-horsepower Standard gasoline marine motors, and is stationed at New York City. During the fiscal year ended June 30, 1909, the *Guard* cruised 6,041.5 miles, using coal as fuel, and consumed for this distance 119.4 tons, which cost at an average of $6.53 per ton, $779.68, or, the cost of cruising one mile was 12.9 cents. During this same period the *Guide* cruised 6,548 miles, using gasoline, and consumed for this distance 9,483 gallons, which cost, at 11 cents per gallon, $1,043.13, or the cost of cruising one mile was 15.9 cents. Therefore, from these two launches, with coal and gasoline at the prices noted above, coal shows an advantage over gasoline of 18.9 percent.

But in New York City for the fiscal year ended June 30, 1909, coal was furnished, under contract, for $2.95 per ton. If the *Guard* had been stationed there, the cost of the coal for the year would have been $352.23 to have cruised the same distance as on Puget Sound, which is at the rate of 5.83 cents per mile, and to have cruised the same distance that the *Guide* did, namely, 6,548 miles, the cost would have been $381.75, as against the $1,041.13 that the *Guide* expended for gasoline, or a gain of 63.3 percent; while if the *Guide* had been stationed on Puget Sound, where gasoline costs 16 cents a gallon in Seattle, it would have cost for the 6,548 miles cruised, $1,517.28, as against $844.69, which the *Guard* would have expended in cruising the same distance on coal at $6.53 per ton.

Shipbuilding Reports.

The Bureau of Navigation reports that 74 sailing and steam vessels of 15,275 gross tons were built in the United States and officially numbered during the month of January, 1910. Of these 38 vessels, aggregating 3,832 tons, were built on the Atlantic and Gulf coasts, and 26 vessels, aggregating 11,276 gross tons, on the Great Lakes. The steel steamship tonnage on the Atlantic coast amounted to only 1,386 tons.

For the month of February, 1910, the Bureau of Navigation reports that 57 sailing and steam vessels of 11,663 gross tons were built in the United States and officially numbered. Of these 22 vessels of 5,607 gross tons were built on the Atlantic and Gulf coasts and 11 vessels of 4,449 gross tons on the Great Lakes. Only one steel steamship of 4,015 gross tons was built on the Atlantic coast during this month.

The report of the Bureau of Navigation concerning the number and tonnage of vessels built in the United States during March, 1910, is very encouraging. The steel tonnage built and numbered during this month exceeds that built and numbered in any corresponding period. One hundred and thirteen sail and steam vessels of 78,257 gross tons are enumerated in the report. Of these, 50 vessels of 20,274 gross tons were built on the Atlantic and Gulf coasts and 14 vessels of 56,831 gross tons on the Great Lakes. The construction of steel steamships on the Atlantic and Gulf coasts comprised 6 vessels of 17,536 gross tons.

Shipbuilding reports for the nine months ending March 31, 1910, show a considerable increase over the corresponding period ending March 31, 1909. According to reports of the Bureau of Navigation, 806 sail and steam vessels of 187,620 gross tons were built in the United States and officially numbered during this period, while for the corresponding period in 1909 only 696 sail and steam vessels of 80,332 gross tons were built. Of the total, 388 vessels, aggregating 82,652 gross tons, were built on the Atlantic and Gulf coasts, 164 vessels of 6,258 gross tons on the Pacific coast, and 138 vessels, aggregating 95,584 gross tons, on the Great Lakes. Thirty-one steel steamships of a total of 58,342 gross tons were built on the Atlantic coast.

Lloyd's Register Shipbuilding Returns.

According to Lloyd's reports there were 386 vessels of 1,057,636 gross tons under construction in the United Kingdom at the close of the quarter ending March 31, 1910. Of this amount 341 vessels of 1,051,667 gross tons are steel steamships. For the corresponding quarter of 1909 there were under construction in the United Kingdom 399 vessels, aggregating 912,272 gross tons, of which 337 vessels of 902,979 gross tons were steel steamships.

The tonnage now under construction is about 144,000 tons more than that which was in hand at the end of the last quarter, and also exceeds by about the same amount the total building twelve months ago.

The figures for warship tonnage now being built (303,685 tons displacement) are the largest reported since September, 1904.

The 29.5-knot destroyer *Perkins* was launched at the yards of the Fore River Shipbuilding Company April 9. The *Perkins* is 293 feet 10½ inches long over all, 26 feet 4½ inches molded beam, and with a draft of 8 feet 4 inches displaces 742 tons. The machinery consists of Fore River-Yarrow water-tube boilers, supplying steam for two Curtis reversible marine turbines 6 feet in diameter, and capable of developing 6,000 horsepower each at about 600 revolutions per minute.

THE MARINE STEAM ENGINE INDICATOR — X.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

REDUCING MOTIONS (CONTINUED).

Fig. 76 shows an arrangement, by means of which the movement of gears like that shown in Fig. 61 is corrected. This is another case of similar triangles. The ratio of reduction is $\left(\frac{x}{x+y}\right)$. A telescopic reducing motion is shown in Fig. 77. It consists of a steel rod working in composition tubes. The velocity ratio is constant and equal to $\frac{x}{x+y}$ as before.

It will be noticed that in all of the gears shown—those which give a correct reduction—the reciprocating motion is transmitted to and taken from the lever by mechanisms of the same kind, the parts being geometrically similar and proportional. With this simple idea in mind, it will be easy to design other forms of correct reducing motions in addition to

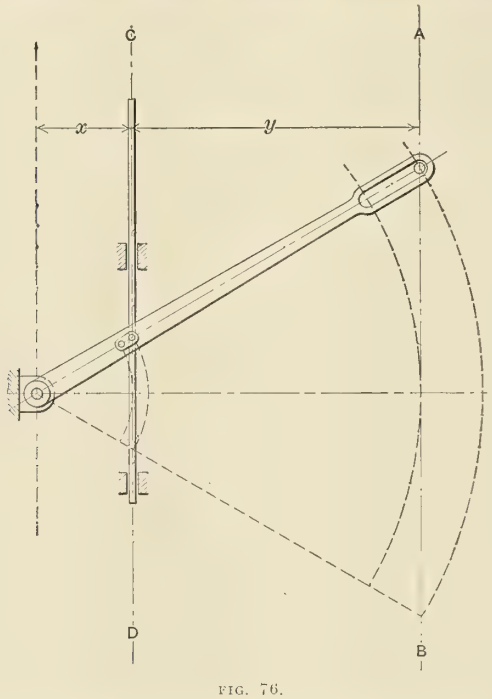


FIG. 76.

those shown above. For instance, suppose it were desirable to make a gear like that in Fig. 62, to give an exact reduction. It would only be necessary to fit a guide rod—parallel to *A B*—provided with a slotted cross-head like that at 7-4 to engage the pin at *D*. The gear shown in Figs. 54 and 55 (March issue) could be corrected in the same way.

As an assistance in getting the proper relation between the guide rod axis and the center line of the indicator cocks, consider the diagram Fig. 78, which shows roughly the top view of an indicator connected to a vertical engine. *A* is the center of the indicator cock; *B* the center of the paper drum; *C* the cord center with the guide-pulley arm in its most extended position, and *C'* the cord center with the guide pulley arm folded against the steam cylinder of the instrument. With a radius *A C'*, draw the small arc *C' D E*, with *A* as a center. About the same center and with a radius *A C*, describe the arc *C F G*. Draw *E G* at an angle of 45 degrees with the line *F H*, the line intersects the center of the engine cylinder and indicator cock. The guide rod center line may be located at any point within the area *C' C F G*, provided that a proper

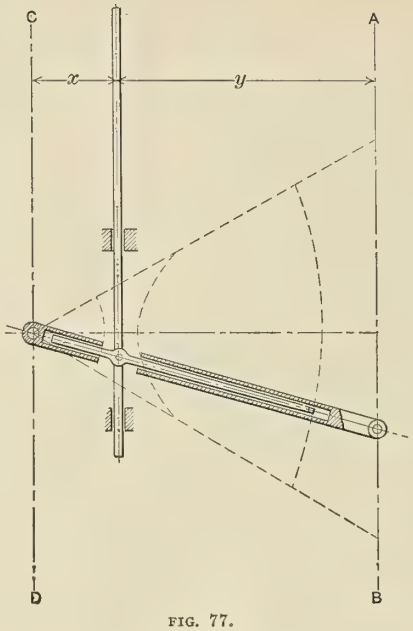


FIG. 77.

amount of room is left for the operation of the pencil-motion swivel head. This can be determined by sketching the indicator on tracing cloth and rotating the sketch on the drawing.

The main lever of the reducing motion may be offset horizontally, if necessary, to bring the guide rod in line, or the guide-rod gear may be driven by a fore-and-aft shaft in the manner often used for revolution counters, but care must be taken to preserve the constant velocity ratio, which is essential to correct reduction. If, however, it is impossible to properly locate the guide rod, fair-leaders or carrying pulleys must be used. The pulley next to the reducing motion must be so located that the cord will lead off parallel or coincident with the center line of the guide rod. If this is not done, all the time and care expended on the reducing motion is wasted. A glance at Fig. 79, which shows an exaggerated case of non-alignment, will show the reader the importance of the loca-

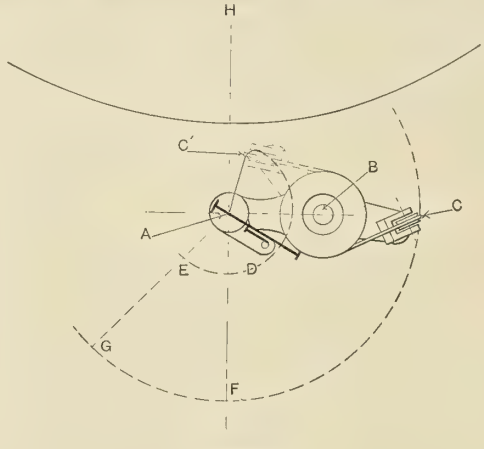


FIG. 78.

tion of this pulley. After the cord has passed this first fair-leader, it may be led in any convenient direction to the guide pulley of the indicator.

To complete this section, but two other forms of reducing motions will be noticed, and while they are not often used on shipboard they may be found convenient in certain situations. Fig. 80 shows a gear fitted to a shaft end, consisting of a crankpin and connecting rod. It gives a correct reduction when the ratio of *A* to *B* is the same as the ratio between the engine crank and connecting rod, and when the angle between *C* and the engine crank-pin center is 0 degrees.

* Copyright, 1910, by Chas. S. Root.

Fig. 81 shows a "lazy tongs" system of levers. This is a pantograph without alterations or substitutions of any kind.

The "hitch strip" *G* is so made that it may be shifted in the holes at *E E*, so as to bring the "hitch pole" *F* in a line passing through the joints *C* and *D*. *C* is connected to the cross-head, and *D* to a stationary support. *F* and *G* are shifted

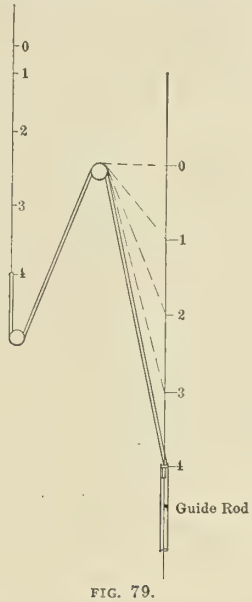


FIG. 79.

to get the proper velocity ratio, and to bring *F* in line with *C* and *D*. The cord is led off from *F*, so that it will be parallel with the line of stroke. With this arrangement the apparatus gives a correct reduction.

Finally, no matter what form of reducing motion is fitted, it should be kept in good condition. Racks should be bolted to

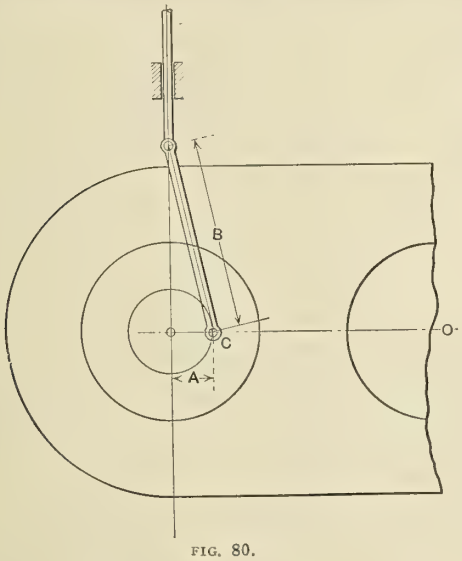


FIG. 80.

one of the bulkheads in a convenient location, and when the gear is not to be used during the next passage, the main lever and its links should be disconnected and stowed in the racks. The mechanism is thus kept in good order and the annoying rattle of a slack gear avoided.

(*To be Continued.*)

The United States battleship *Florida* will be launched May 12 from the Brooklyn navy yard. Her sister ship, the *Utah*, was launched at the works of the New York Shipbuilding Company last February.

FUEL OIL—II.

BY E. N. PERCY.

The physical characteristics of fuel oil, so far as the power engineer is concerned, are, briefly, as follows:

In color fuel oils vary from brown to black. Very light brown, or light green, indicate, roughly, a light oil, full of gas. This should be handled carefully, is characteristic of light, unrefined oils, distillates and paraffin base oils. Heavy brown and black oils are asphaltum base, and are lighter when this is removed. The fluorescence of all oils is green, but changes to blue in the kerosenes and light lubricating oils. Asphaltum base oils, if boiled away, will, roughly speaking, leave an asphaltum residue, while paraffin oils will leave paraffin, vaseline, etc., as a residue.

The specific gravity varies from 1.025 to 0.749, and is always stated in terms of Baumé scale. Market fuel oil ranges from

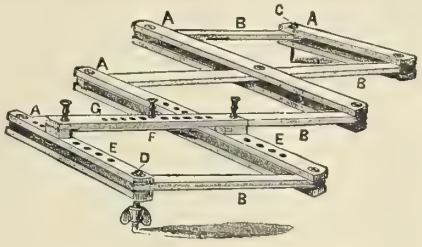


FIG. 81.

13 to 16 degrees Baumé. The gravity is the most important method of classifying fuel oils, but it must not be confused with viscosity or stiffness. A very stiff oil that will not flow without heating may be of light gravity, or a very watery, light-flowing oil may be very heavy in gravity. Oils are rated in gravity at 60 degrees temperature Fahrenheit, and heating them lightens their gravity from 2 to 3 degrees Baumé for every 100 degrees temperature Fahrenheit.

The specific heat of petroleum is, in general, 0.511.

The latent heat of vaporization is variable, but averages one-ninth that of water.

Detecting the odor is an important method of inspection, but must be learned by experience. Some wells furnish oil with very objectionable odor, some refineries furnish a fuel oil with the same characteristic. Others smell sweet. While little can be told of the ingredients by the odor, it is easily possible for an experienced man to know where the oil comes from by the color and odor. Any large quantity of sulphur can be immediately detected by the odor; but the engineer cares very little about this constituent one way or the other. It is said that it forms sulphurous acid, which attacks the iron of the boilers, but observing engineers do not bear out this theory.

The viscosity ranges from heavy semi-solid oils that have to be heated to be handled to less than 1.00, which is the viscosity of water. These very heavy thick oils are gradually being used for other purposes, such as road making, or distilled for asphaltum and paint, and fuel oils are becoming lighter and more uniformly classified. An average viscosity would be 1,000 for 14 gravity, 400 for 16 gravity, 75 for 18 gravity, and 15 for 20 gravity. Oils of 20 degrees gravity flow easily under moderate head, 18 may be piped readily, but heavier than this requires a good pressure or heating, or both. The viscosity is measured by the number of seconds it takes a measured amount of fluid to flow from an orifice, water being one. Viscosity falls very much more rapidly than the gravity when the oil is warmed up, and an increase from 60 to 110 degrees F. with an average fuel oil of, say, 16 gravity and 300 viscosity will reduce the viscosity to 30 or 40; in other words, it will be ten times as thin as before, and can be pumped with perfect ease. Average fuel oil, warmed up to 100 degrees F., will require 50 percent more power to pump than water

under exactly the same conditions; but a slight difference of conditions will change this proportion greatly.

The flash point, or the temperature at which oil will ignite, is another important characteristic usually embodied in specifications, especially for protection against fire and explosion. It is the point at which oil gives off vapor at a temperature that will flash or ignite. It ranges from 60 to 400 degrees F. Zero is obviously too low, as most fire-rooms will run to 150 degrees temperature at times, and this heat, communicated to the tanks, would keep them covered with inflammable gas at all times. On the other hand, if the flash point is too high, it in itself is of no harm, but indicates a heavy oil, with little or no light constituents. The accepted flash point for marine work is not less than 150 degrees, but it is probable that a somewhat higher figure would be better, as this admits many crude oils, on a pinch, that really have some light parts that vaporize in a warm tank. One ship that was blown all to pieces in San Francisco Bay was afterwards found to have had 85 gravity oil in one of her tanks. The tanks were all nominally empty, and were being overhauled; but it is probable that they were filled with certain light vapors mixed with air.

The calorific value averages 18,000 British thermal units for all kinds of fuel oil, and in comparison with coal, the following factors, established by practice, should be considered: First, the calorific value of the coal in question, which varies from 7,000 to 14,000 British thermal units; second, the heating efficiency of the oil fire as compared to the coal fire, which happens to be slightly in favor of oil, but the evaporating capacity is greater, that is, oil will evaporate 4.5 pounds of water per hour per square foot of heating surface and at 80 percent efficiency. This may be hard on the boiler, but that has not yet been proved.

Impurities in fuel oil, if crude from the well, consist of sand, mud, lumps of asphaltum, gravel, light oils, clots of heavy oils and sulphur; all of this is supposed to be removed by responsible sellers of petroleum and is, in addition, provided for in the specifications of all large users of fuel oil, such as steamship companies.

Fuel oil is not harmful to metals, pipes or brick. It is harmful to rubber, fabrics, concrete, paint, bright work and fine working parts that might gum up.

The vapors and gas from petroleum are liable to asphyxiate if confined; hence one should never go into a tank or riser unattended, never with a naked light.

Petroleum rapidly becomes thick and asphalty by standing in the sunlight, and any fuel oil that has been long in the sun should be looked upon suspiciously as being pretty heavy and liable to give trouble in pumping.

There is an average of 1 percent moisture in fuel oil, some coming from the well, the rest coming from the steam in the stills. It is of no especial importance except in making fine corrections in fuel tests.

A well-known very strict specification for marine fuel oil reads as follows:

Specific gravity between 15 and 17 Baumé.
Corresponding weight per barrel of 42 gallons, 336 pounds.
Heat units per pound of oil, 18,000.
Moisture limit, 1 percent.
Sulphur limit, ½ percent.
Silt, etc., none.
Flash point, not less than 200 degrees F.

A somewhat more lenient specification is as follows:

Specific gravity, the oil must be readily pumped.
Weight per barrel, not specified.
Heat units per pound of oil, not specified.
Moisture limit, 5 percent.
Flash point, 130 degrees F.
Sulphur limit, 2.5 percent.
Silt, etc., ½ percent.

The first oil burns beautifully, without special features, and is easily procurable in oil countries at a reasonable price. The second oil is very gasy and explosive, because of the low flash point, permitting light constituents; it often flashes back into the fire-room, because of the suddenness with which the light parts ignite; it sputters and threatens to go out because of the high percentage of moisture, and gives off very offensive sulphur fumes, because of the high percentage of sulphur, which could only be prevented by an excess of draft, and the burners clog occasionally with the ½ percent of silt. The foregoing shows the advisability of specifications for fuel oil and of purchasing from reputable firms.

It is perfectly possible for any engineer to be provided with all of the simple instruments for determining any of the following characteristics of fuel oil: gravity, viscosity, flash point and impurities. The most important are the gravity and flash point. The viscosity relates only to pumping, and the practical engineer can learn all he needs to know by spreading a little of the oil on a piece of iron warmed to about 130 degrees F. He can smell it for sulphur, as 2.5 percent will smell strong in a closed tank when at 60 degrees, and 1 percent is hardly perceptible in comparison. The flash point is taken with a very simple instrument that will be explained by any dealer in chemical goods.

Oil fuel, when adopted by a steamship company, is handled in one of four ways. Either the oil firm's scow comes alongside at a regular hour, and pumps in fuel, or the steamship goes to the oil dock, which does not take long with the huge pipes and pumps used, or, in some cases, the steamship company has a private pipe line from the oil companies' pumps, or they maintain a private supply in their own tanks. The oil may be bought under contract, and delivered according to terms, or it may be bought in lots at advantageous terms and privately stored. Also, it can be purchased in lots and ordered stored by responsible firms, but this should not be attempted by people not familiar with the business.

The Federal government has not made set rules for the carrying of fuel oil, but a combination of their practice, the reports and recommendations of their various officials, and the business as actually practiced would read about as follows:

Permission must be obtained from the Secretary of Commerce and Labor and the Supervising Inspector General at Washington, through the local inspector. Blanks will be furnished for this application, which must be accompanied with complete drawings as specified, showing in detail the proposed fuel oil tanks, with dimensions, capacities, position, etc. The tanks may be located to suit the design of the vessel, but it is not customary to put them in the double bottoms under the boilers, nor in the wing bunkers, nor is the after bunker popular, because of the many pipes, etc. General practice has included the forward bunker and double bottom under it and any space forward of this. Small boats frequently carry tanks lashed to the decks, but this is not fully approved, as these tanks sometimes get adrift in rough weather. Fairly complete specifications, with scantlings, recommendations, etc., for construction can be found in the Manual for the Marine Engineers' Beneficial Association for 1904.

To use a bunker directly it is simply calked up, a cofferdam, 2 to 4 feet deep is bulkheaded off next the fire-room, and filled with cellulose or water, to keep the oil out of the fire-room in case of collision. Then the bunker, if in a large ship, is divided into two or four tanks, or if in a small ship it is simply provided with baffle plates to keep the oil from surging. Some ships use the double bottoms throughout, but the inspectors now do not favor oil in double bottoms under the fire-rooms. Some boats use cylindrical tanks stowed in bunkers or holds, or even in the wing bunkers.

The propeller ferryboat *Berkeley*, one of the fleet before referred to, of 1,245 tons, 260 feet long, 40 feet beam, 1,600 horsepower, was converted into an oil burner from a coal

burner for $1,700 (£350). The oil is carried in four upright cylindrical tanks, 7 feet diameter by 10 feet high, placed in the corners of the old bunkers. This boat runs 18 hours out of 24 at least, and takes oil every other day. A 5,000-horse-power ocean liner that is just being changed over (the writer is not at liberty to mention the boat), by carrying the fuel in the forward bunker, and extending this four frames on one deck only, will cost about $18,000 (£3,700) to make all the alterations. This boat is being arranged to make trips of 180 hours' duration without refueling, including gross fuel used for all purposes.

In order to make use of the cheapest grades of fuel oil, and to be prepared to take any oil at any port, provision must be made to heat the oil with steam. The amount of surface necessary can be figured upon the data given in the first part of this article, also the amount of heat. In general, heating the oil in the tank is not allowed, as the temperature is cumulative up to the temperature of the heating agent, and in the course of a week or a month at sea the flash point might be exceeded, and the tank filled with gas, or the oil take fire at some leak; still, if the oil is very heavy it may be necessary to warm it some in order to handle it at all. Such oil will invariably have a high flash test of 200 degrees or more, hence could be warmed to 150 degrees with perfect safety. From 140 to 150 degrees is the point of maximum thinness for all oils; that is to say, they do not thin out perceptibly for several hundred degrees above this, hence 145 degrees may be accepted as the standard point to which it is advisable to warm oil for pumping, provided the flash test is 200 or more. This is done by putting steam coils in the car or tank, or bunker as the case may be. A good practice is to put a small coil right around the pump suction, but no more; this makes the oil flow easily to the pump, but any superfluous warm oil or gas is condensed before it has risen very far in the tank, especially in a bunker tank, with the sides next to cool sea water.

The following represents the properties of average oil:

Gravity.	Maximum Thinness Degrees F.	Flash Test.
14	150	250
16	140	240
18	110	175
20 and 22	100	130

Lighter oils than 22 are seldom used for fuel purposes, and would be most unsuitable for marine purposes on account of their volatility.

If the oil be of 18 gravity or lighter the pump and connections need not be any different than as though arranged for the same quantity of water. If, however, as is usually the case, the oil be of 14 or 16 gravity, the pump should be at least five times as large at the water end only, on account of the very low velocity necessary, and all the suction valves should have the spring tension reduced to the least possible.

In any case, a heater should always be provided between the pump and burner. It can take any suitable form, and should be constructed for a working oil pressure of 60 pounds, which is pretty well established for all systems in general use. Steam is always used for heating, and the surface proportioned according to the transmitting factor and the specific heat of the oil.

Two systems of piping are in use: the open system, in which the oil makes circles all the time through the heater and burner pipes and back to the pump suction pipe, and the dead end system, in which the oil simply goes to the burner. For marine work, the open system should be used, as in case of a shut down for some time, the oil cools and stiffens in the pipes, and if a heavy fire is wanted right away the oil does not spray so well, and carbonizes, or even backfires into the fire-room, which is very unpleasant sometimes.

Gas from the oil collects in all pockets, and provision should be made to blow it off. It should not be blown into open fire-rooms, etc., but carried overboard or into escape pipes. First-class installations now are made with central regulation; that is, instead of jumping from one burner to another the pressure on them all is controlled from the oil pump, either automatically or by hand, and any fire wanted, or no fire at all, just by controlling the oil pressure. No ells should be used in an oil system; rather all crosses, with plugs in the unused holes, so that any pipe may be readily cleaned of obstructions. All valves intended for purposes of fine regulation are specially constructed, as the ordinary market valves will not regulate in proportion to their opening. Fuel oil should be strained at every possible point, from the well to the burner, and twin Macomb strainers make a fine combination for oil fuel lines. Shut-off valves on all oil lines must be controlled from the deck, especially those next to the tank. The government makes no ruling from the time the oil leaves the pipe and enters the burner, leaving it to the judgment of the local inspectors, who in turn depend largely upon reputable firms who make the installations.

(*To be continued.*)

LENGTHENING THE SIDE WHEEL PASSENGER STEAMSHIP RANSOM B. FULLER.

BY ROBERT C. MONTEAGLE.

Among shipbuilders and others who are familiar with such work, it is thought that the lengthening of the *Ransom B. Fuller* was accomplished by very skillful methods, and, in addition, great care and thought were exhibited in the working out of the numerous details connected therewith. The work was contracted for and performed by Mr. William McKie, of East Boston, the vessel being one of the large fleet of passenger steamships of the Eastern Steamship Company, of which Mr. Calvin Austin is president, operating between the ports of Boston and Bath, Me.

The vessel is of wood, has side wheels, and is a passenger and freight steamship, built in 1902 by the New England Shipbuilding Company, of Bath, Me. She has three decks—main, saloon and gallery decks. Accommodations are all first-class, and are distributed on all decks, the dining saloon being on the main deck.

The machinery consists of a beam engine, with a cylinder 63 inches in diameter by 132 inches stroke. Steam is furnished by two boilers, of the fire-box, flue and return tubular type, each fitted with a steam chimney opening into one common smokestack. The boilers were built for a working pressure of 55 pounds per square inch. Before lengthening, the vessel was of the following dimensions and capacity:

Length over all	277 feet 6 inches.
Beam, molded	40.1 feet.
Depth to main deck	14 feet.
Gross tonnage	1,862 tons.
Sleeping accommodations	650 passengers.

The frames are double, 6 inches by 15 inches at the heel and 6 inches by 8 inches at the gunnel, spaced 24 inches centers. The planking is 3½ inches, the ceiling 8 inches, 6 inches and 4 inches. The diagonal strapping is ½-inch by 4-inch steel. The following is a brief description of the alterations which have been made:

Previous to hauling out, the joiner work of the vessel had been cut as far as practicable while she was afloat. On Oct. 28, 1909, she was hauled out on the marine railway at the Atlantic Works, and cut apart forward of the boilers, in the manner shown in the drawing and photographs. The forward body was then blocked up, and on Nov. 6 the cradle, with the afterbody, was hauled back a distance of 40 feet, the amount

which it was desired to lengthen the vessel. It is self-evident that by adopting this method of separating the two bodies they must be in absolute alignment, and ready for the work of filling in the 40 feet of additional length. The illustration of the lines shows that although only 40 feet were added to the length of the hull, yet in order to get fair lines it was necessary to remodel 147 feet of the hull. This made necessary the installation of fifty-two new frames complete, and the building up or reduction of those remaining in the remodeled portion of the hull.

Fig. 1 shows the vessel hauled apart ten minutes after the work was started. She had been hauled apart about 10 feet during that time.

Fig. 2 shows the vessel hauled apart the desired 40 feet. This was fifty minutes after work was started. The men who did the work are standing in front of the hull.

Fig. 3 shows a profile view of the vessel six weeks after work was commenced.

Fig. 4 shows the vessel completed shortly before making her first trip. It may be noted how fair the lines of her sheer and joiner work are, no break of any kind being visible. The launch took place on Feb. 11—no effort was made to get her ready sooner, as she was not required to run until the opening of the spring season.

Fig. 6 shows one of the Howe trusses, built into the vessel, one on either side, between the keelsons and the main deck,

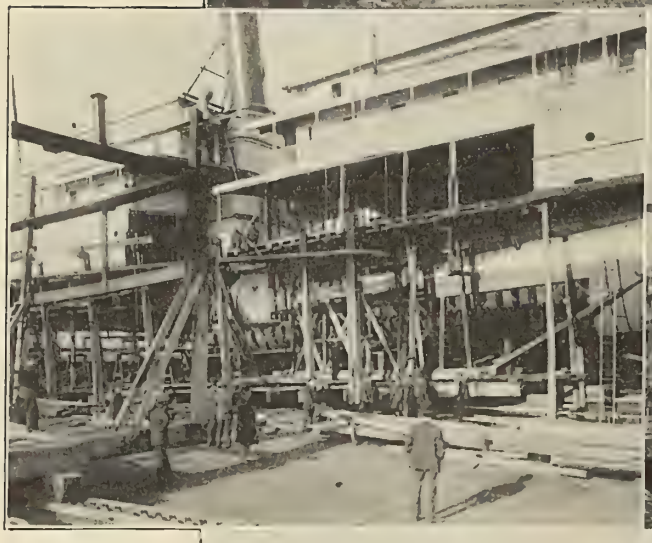


FIG. 1.

FIG. 2.

FIG. 3.—PROGRESS OF WORK AFTER SIX WEEKS.
FIG. 4.—THE VESSEL AFTER REMODELING.

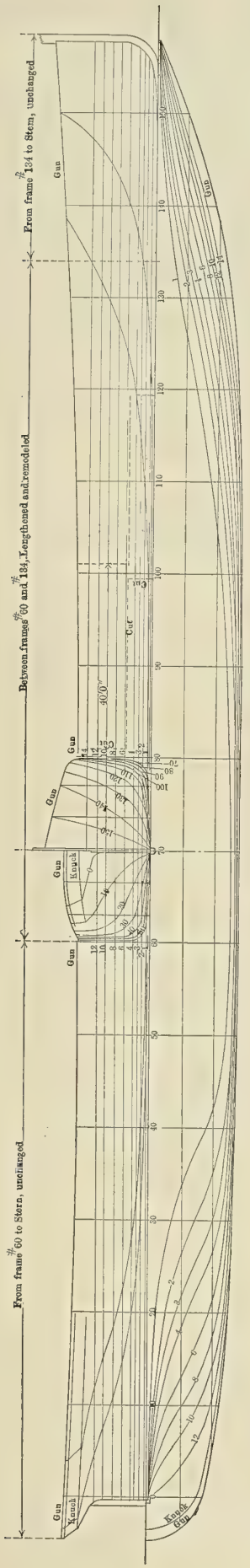


FIG. 5.—NEW LINES OF THE RANSOM B. FULLER.

making two trusses the full depth of the vessel, extending fully two-thirds of her length.

Figs. 1 and 2 show how the diagonal strapping was cut, which had to be renewed after the new frames were in place.

As altered, the vessel has eighty-three additional staterooms, constructed for two passengers each, giving sleeping accommodations for 166 additional passengers, making in all sleeping accommodations for 816 passengers besides her crew of sixty men. Ten carloads more freight can be carried than before the change, all this being carried on the main deck. The new gross tonnage is 2,329.76 tons. The draft aft is 10 feet 8 inches, and forward 8 feet; mean draft, 9 feet 4 inches—the effect upon the draft of the change being to lessen it approximately 10 inches. This of itself was very desirable, as the wheels now work at a much more effective draft.

At this writing the *Fuller* has made two trips, and the results are very gratifying. She steers better, runs faster and

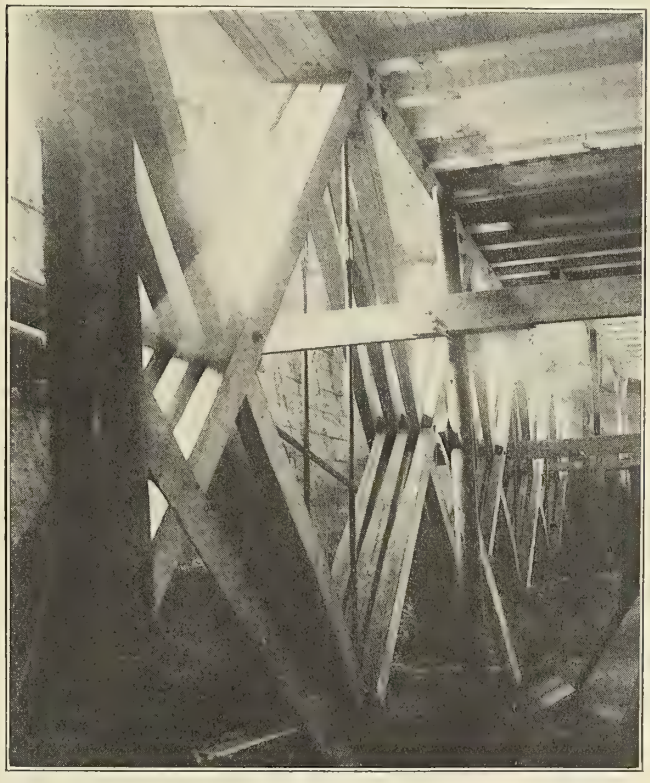


FIG. 6.—ONE OF THE HOWE TRUSSES WORKED INTO THE HULL.

makes her running distance on less coal than at any time of her career. As the vessel stands to-day she has a large increase of longitudinal strength over her previous condition; this superior strength being due to four extra heavy keelsons fitted, and to the immensely strong Howe trusses built on either side of the vessel, as illustrated in Fig. 6. To sum up, it may be said that this work of lengthening a wooden vessel was carried out with great skill and in a manner highly satisfactory to all concerned.

The Colossus, the first to be floated of the eight warships provided for in the British naval programme of the past fiscal year, was launched at Greenock April 9. The *Colossus* has a displacement of 20,250 tons, and is designed for a speed of 21 knots. The main battery comprises ten 12-inch guns, the secondary battery consisting of 4-inch guns. She was launched in nine months from the date of laying the keel. Her principal dimensions are: Length, 510 feet; beam, 86 feet; horsepower, 25,000. The *Hercules*, sister ship of the *Colossus*, building at the yards of Palmer's Shipbuilding & Iron Company, will be launched May 10.

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OF
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No. of Bearings	R. P. M.	Load in Lbs.	Time M.	Time S.	
1	400	3000	2	15	VICTOR VANADIUM BRONZE
2	400	2000	1	30	VICTOR VANADIUM BRONZE
3	400	2000	1	45	VICTOR VANADIUM BRONZE
4	400	2000	1	00	REGULAR BEARING METAL
5	400	2000	1	15	HIGH GRADE BEARING METAL
1	400	3000	2	15	VICTOR VANADIUM BRONZE
2	400	2000	1	30	VICTOR VANADIUM BRONZE
3	400	2000	1	45	VICTOR VANADIUM BRONZE
4	400	2000	1	00	REGULAR BEARING METAL
5	400	2000	1	15	HIGH GRADE BEARING METAL

Composition No. 1. Type "C" Special Victor Vanadium Bronze.
" No. 2. Type "B" Superior Victor Vanadium Bronze.
" No. 3. Type "A" Regular Victor Vanadium Bronze.
" No. 4. 81% Copper, 9% Tin, 6% Lead, 4% Spelter, Trace of Phosphorus.
" No. 5. 84% Copper, 12% Tin, 4% Lead, Trace of Phosphorus.

Each of the samples of metals was placed on the machine twice. It will be noted that the time of run checked up exactly in each case. The bearings were placed upon a shaft, $2^{15}/_{16}$" diameter, and the bearing surface in each case was 9 square inches. The speed throughout the test was the same, 400 revolutions per minute, 50% more load was applied to special Victor Vanadium Bronze composition, and it's time of run was much greater than the other metals. The load applied amounted to 333.33 lbs. per square inch in special Victor Vanadium Bronze bearing, and 222.22 lbs. per square inch in all the other bearings.

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PRACTICAL EXPERIENCES OF MARINE ENGINEERS.*

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Alterations to the Water Ends of Pumps.

While serving in one of our small cruisers in the Orient, it became necessary to overhaul and refit the water-end packing of all our main and auxiliary feed and the engine-room fire and bilge pumps. There were two main feed, two auxiliary feed and two fire and bilge pumps, all the same size, each being 9-inch by 6-inch by 6-inch double pumps, made by Watson & Son, in England. Just before leaving New York for

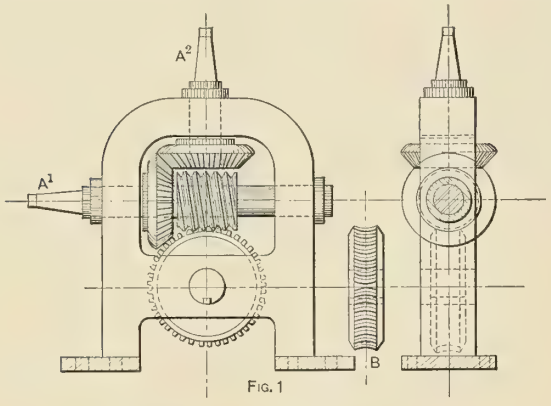


FIG. 1

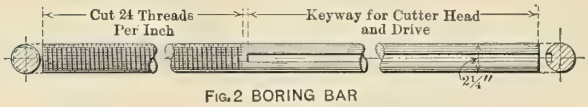


FIG. 2 BORING BAR

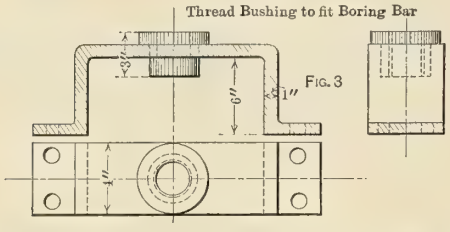


FIG. 3

Manila, the water ends of these pumps were rebored, each water end of each pump being left a different size, varying by sixty-fourths. They were then fitted with a solid brass packing ring, 2 inches wide, and four sets of these rings were sent on board for spares.

The job was a hurried one, and was an exemplification of the familiar saying among sea-going engineers, "that some of the people who design and build pumps and their acessories should be sent to sea with them." The pump cylinders were all bored taper, and the new rings were poorly fitted to start with, and by the time we reached Manila it took both main and both auxiliary feed pumps to keep the water up in three of the four boilers.

Upon our return to Cavite, after a voyage up the China Coast, it was proposed to take the water ends of the pumps ashore, rebore them, and fit new packing rings, the same as the old ones. As the old ones were decidedly too narrow there was nothing to be gained by fitting new rings similar to the old ones, when by a slight alteration in the water pistons and followers, rings nearly three times as wide could be fitted.

When it came to take the water ends of the pumps ashore it was found that to get the water ends of the two main and the two auxiliary feed pumps out of the fire rooms would require disconnecting all of the port after auxiliary steam and exhaust piping, in order to pass the pump-ends over the top of the port after boiler, the only place where they could be passed between the boiler and the protective deck, which was of 3-inch steel. The Chief suggested that we cut out part of the front connections of one boiler, then pass them up through one of the smokestacks. But, upon investigation, this method had to be abandoned, since there was a battle-grating in the base of each stack, and this was made of 6-inch by 1-inch steel bars, securely riveted to heavy bulb iron beams.

It was then decided that if the navy yard would supply the castings we would rebore the pumps in place with the ship's force, a job which the navy yard force declined to consider, saying that they had no small boring bar, and that the ship would not remain long enough at the yard to give them time to make the bar and do the boring. The castings were procured, and, when brought on board, finished nearly to size from our drawings, except turning down to size on the outside.

Then came a hunt for something which could be rigged up for a boring bar, for 10-inch water ends are pretty large to bore out with a direct-driven bar and a No. 3 ratchet. In looking around I discovered a rig, shown in Fig. 1, that was secured to the center-line bulkhead between the engine rooms, and was for the purpose of closing by hand the two watertight doors over the engine rooms in the protective deck. The only alteration made in this rig was to remove the original shafts and substitute two short shafts fitted with tangs, as shown, to fit our No. 2 air drill. The rest of this gear was used as taken from the bulkhead. The worm-wheel B, Fig. 1, was inserted in a slot in the frame from the bottom, and was fitted with a key that was riveted in place, and the wheel, being between two sides of the frame, took care of the thrust. The boring bar was made as shown in Fig. 2, threaded for one-half its length to form the feed, and slotted the other half to drive the cutter-head and to fit the key in the worm-wheel, to act as the drive.

As all the cylinders had to be counterbored the bracket, shown in Fig. 3, was made and the bushing threaded 20 threads per inch to act as the feed; the bracket, setting off six inches from the cylinder, allowed the cutter head to pass clear through the cylinder. The castings were furnished to our sketch and were made as shown in Fig. 5, except that they were 6½ inches long by 6⅜ inches in diameter.

We made a boring-bar from a piece of 1¾-inch machinery steel, fitted as in Fig. 2, with the exception that we fitted a tang upon the unthreaded end, to fit our No. 3 ratchet. The cutter-head, Fig. 4, and the bracket, Fig. 3, were the same as used upon the job to be described below. Each pump was bored and counterbored, and all twelve water ends were bored exactly the same size, 6¼ inches. The sleeves for the water pistons were turned to a neat fit, and four water grooves were turned into each, and these pumps gave no further trouble during the next four years.

Several years later, when, on joining one of our large armored cruisers, I found the two engine-room fire and bilge pumps, 14 inches by 10 inches by 14 inches, as well as two auxiliary air and circulators fitted with fibrous packing in the

* We pay for these articles.

water-end pistons, which gave no end of trouble, as the pump cylinders were quite badly worn. These pumps were an almost constant repair job for two machinist mates. The water-end cylinders, due to wear and having no counterbore, would cause the pumps to stick at the end of the stroke. It was decided to rebore them and counterbore them, and fit the water pistons with the sleeves, as shown in Fig. 5. The bracket, Fig. 1, was lined up, so as to stand off the cylinder face about six inches, so as to give plenty of room to set the tools. The cutter-head was made of a pair of brass blank flanges, slotted to fit the 5/8-inch square tools and bolted together, as shown in Fig. 4, by the bolts C', C'', C''', these bolts also serving to jam the tools in place when set. The tools being set out by means of a taper pin driven behind them into the holes D', D'', D'''. By this means each tool could be accurately and quickly set.

When the bar was set up and ready to start, our No. 2 air drill was placed upon the tang of shaft A^2, and the cut ran clear through the cylinder; the air drill being now reversible it was shifted to the other tang, A^1, and the cutter-head run in the opposite direction until out to the edge of the bore, then the cutters were reset and another cut taken. The cylinders were all bored and counterbored, and our improvised boring bar worked admirably. The 10-inch cylinders were bored to 10 1/8 inches, and all of them exactly the same size, while the 8-inch were bored to 8 1/8 inches, care being taken to finish them exactly the same size. The original pistons being fitted with five turns of 1/2-inch square tucks-packing. This gave but 2 1/2 inches of bearing measured longitudinally with the bore. It was found by careful measurements that our new packing sleeves could be left 8 3/4 inches long. This would allow the sleeve to over travel in the counter-bore about one inch on each end of the cylinder. These sleeves were made a sliding fit between the follower and the piston, thus allowing the springs and adjusting screws to be replaced as before and the pistons centered in the same manner. But the outside surfaces of the sleeves were made a snug fit in the bore and had to be tapped in with a block of wood. The cylinders were then oiled and the pumps run "dry" for several hours at slow speed, so as to obliterate all the toolmarks. Each sleeve was fitted with six water grooves, as shown in Fig. 5, the grooves being 1/8 inch deep and 1/8 inch wide, rounded at the bottom.

Fig. 6 shows the relative bearing surface of both the old and the new packings. The first of these pistons to be finished, as shown, had been running nearly two years before I left the ship, it being one of the engine-room fire and bilge pumps, and was used on bilges and for deck purposes, as well as for evaporator circulating. At the end of this time a careful examination was made of the fit by removing the top head of the water cylinder. The bore was a perfect mirror, and by filling the pump cylinder with water, then inserting the piston and sleeve, it would not sink of its own weight, but stood for over an hour at one spot.

Even by increasing the length of the water packing sleeve, as shown, the ports still remained open, largely in excess of the area required by the size of the pipe and connections. Should it have become necessary to repair these sleeves at any future time, I would have taken a heavy cut off the outside, then turned four or five dove-tailed grooves, trimmed and babbitted the outside of the sleeves, and then turned them down to a good fit in the bore. I have since finished pump sleeves in this manner, and find the job a most satisfactory one.

It is a great deal of satisfaction to the man "on watch" to see pumps run perfectly watch after watch, after he has spent nearly every other watch repacking water pistons of pumps that were never right from the day they were started. Why pump makers will persist in sending out pumps without counterboring the water ends is apparently past finding out. But this is true of all the piston pumps, direct-acting, from the main air pumps of 38-inch bore down to the diminutive little parody on a pump of 1 1/2-inch bore that feeds the launch boilers.

As soon as a liner becomes worn a little the pump sticks, then the oiler on watch will readjust the valve gear in order to shorten the stroke and keep it from sticking again on his watch; and, to make sure that it won't trouble him again, he shortens the stroke enough and a little to spare. It is no uncommon thing to see a pump of a nominal stroke of 12 inches making a bare 10-inch stroke. The fire and bilge pumps that I have just described were of 14-inch stroke, but were making but a 11 1/2-inch stroke by actual measurement at the time of

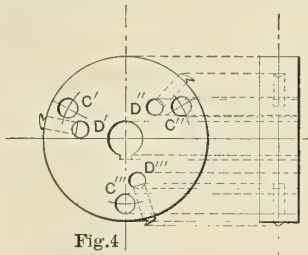


Fig.4

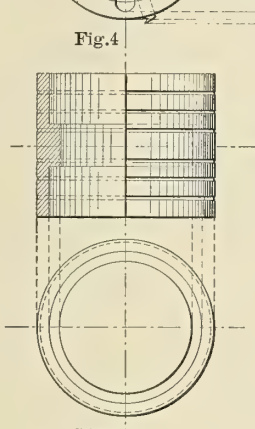


Fig.5

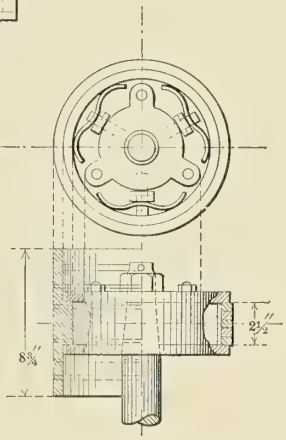


Fig.6

reboring. After the water ends had the new sleeves fitted and the steam valves overhauled and refitted they would make 14 3/4 inches stroke without a sign of sticking at the ends.

The hot well pumps were 14 inches by 16 inches by 16 inches, and were found to make but 14 inches stroke without sticking, but on reboring and fitting with sleeves to travel over the counter bores no trouble at all was experienced in getting them to make 17 1/4 inches stroke. In turning down the pistons and followers, in order to fit them to the new sleeves, enough was taken off to allow the sleeve to slide from side to side 1/16 inch, to allow for adjustment in centering when in the pumps.

E. A. Blackwell, U. S. N.

Kingston, N. Y.

Breakdown of a Main Circulating Pump at Sea.

We left Liverpool on December 3, 1905, in a steamship bound for Calcutta, with 10,000 tons of general cargo. All went very well with us until we were just about half way up the Red Sea, going east. The main engines were running at 65 revolutions per minute when, without any warning, there was a tremendous knocking in the low-pressure cylinder. My first action was to shut steam off the main engines by throttling. I then made my way round to the back of the engines, and there I found one of the main circulating pumps stopped, and on examining it I found the connecting rod had broken just below the fork end. Steam was shut off this particular

engine as soon as I could get at it, and repairs were started as soon as possible.

Our first job was to dismantle the broken rod, and having done this we started repairing it. It was broken about one inch below the fork end. As we were on a tramp ship we were not gifted with any too much spare gear, and I might say one of the things we did not have was a spare rod. The repair of the rod was as follows: A hole 1⅛ inches diameter was drilled and tapped in each half of the rod; then a stud was put into the bottom half and the fork end was screwed into it. We started to get the engine together again and in a short time it was running once more, although at a much slower rate than before the accident.

It would be well for my readers to note that on this occasion the temperature of the sea water in the Red Sea was very nearly 100 degrees; to be correct I think it was 98, so you may well imagine the two circulating pumps had all their work cut out to keep the main engines going at a fair speed. However, it stood to our credit that the repairs effected carried us to our port and there we got a new rod. F. J. N.

Repairing a Broken Sea Valve Box at Sea.

The breaking of a boiler blow-down valve box on the ship's shell occurred with the writer in mid-ocean, heading westward. The valve box was made of cast brass and contained three valves. Each valve was connected to an independent blow-down pipe. The valve box was secured to a cast brass pedestal about 16 inches in depth, placed in the center of a fore-and-aft stokehold, between two floors on the port side of the keelson, and joined to the garboard strake plating. A corresponding valve box similarly fitted was fixed on the starboard side of the keelson. As the vessel was not supplied with an evaporator, sea water had to be used for the extra feed makeup, and when the water in the boilers exceeded a certain density they were blown down. On one of those occasions it was observed that some part in connection with the blow-down system underneath the platform had given out. An inspection showed that an inrush of sea water was coming from

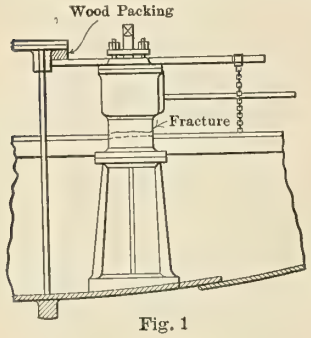


Fig. 1

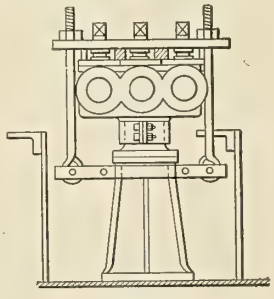


Fig. 2

a point below the body of the valve box. It was thought that the joint between the flanges of the box and the pedestal had failed, but a closer inspection showed that there was a fracture on the trunk of the valve box about 1¼ inches from the top and extending about 15 inches round the circumference, leaving about 3 inches of solid metal holding the parts together, as shown on Fig. 1. As a temporary measure, a stout bar was placed across the top of the box, one end of the bar being placed underneath the top angle bar of the keelson, and the other end secured to the valve cover by means of a Spanish windlass, as shown also on Fig. 1.

Preparations were then made for executing a lasting repair. Two half bands of wrought iron of sufficient thickness and width were forged, fitted together and fastened in position by four ½-inch bolts, with a rubber insertion joint round the fractured part of the box. When tightened up, it made a completely tight joint. A clamp equal to the diameter over the webs of the pedestal was then forged, leaving the lugs sufficiently long to project beyond the ends of the box, and bolted in place underneath the top flange of the pedestal. To the ends of the clamp lugs were bolted two prepared eyebolts, which stood up at the ends of the box. A strong back was made from a piece of plate, with clearance holes, to allow the valve spindles to pass through. The gland studs were removed, and the strong back placed in position over and resting on the glands, and on strips of hard wood placed on the valve covers, the temporary bar was then drawn out and the coupling bolts tightened up. The complete repair was as shown on Fig. 2.

With this repair the vessel completed the round voyage. On arriving at the home port, as there were no convenient facilities for docking, a diver was sent down. He took the sizes of the blow-down apertures, and two wooden plugs were made to fit them, which he took down and placed in position. The valve boxes were then removed and blind flange plates were fitted and joined on to the pedestal. In place of the valve boxes, two suitable single-way cocks were made and fitted, and the blow-down system altered to suit. The diver then removed the plugs from the ship's bottom.

James Bell.

A Leaky Condenser.

I write of an incident which happened while at sea about 1,200 miles from New York, on a British Atlantic liner carrying the royal mail. I might say that this liner belongs to the premier line of Great Britain.

We left New York for Liverpool on a Saturday in October, 1908. The weather for the most part of the voyage was very rough. Being one of the engineers whose duty it was to spend much time in the stokeholds, I had occasion to take particular notice of the water in the boilers. I found on entering the stokehold that the water level in the boilers (nine in number) was rather high. At this time we were only twelve hours from New York. I returned to the engine room and examined the extra feed cocks, and found them all in good order and shut off the boilers. I once more returned to the stokehold, this time armed with a salinometer pot and salinometer and took the density of the water in the boilers. The salinometer registered 7 ounces of salt to the gallon; I came to the conclusion that this density was too high with another 5½ days to run, so I blew about 3 inches of water out of the boilers. Two hours afterwards I again tried the density and this time it had been reduced to 5 ounces to the gallon. I decided to let it go at this, for a watch at any rate. My watch now being up I was relieved and I told my relief what had happened and advised him to keep his eyes open. This he did without anything alarming having happened.

I now came on watch again, eight hours having elapsed since I left the boiler rooms. On looking at the water all around I found that it was about 2 inches higher than when I left it. I at once tried the density again and found that it was up to 8¼ ounces to the gallon this time. I became rather anxious as to the cause of this increase of water in the boilers, also at the height of the density. I had a pretty good idea that the trouble lay in the main condenser, and as I found out afterwards, I was right. I blew some more water out of the boilers, this time to the extent of 6 inches, and now watched them more carefully than ever. In the space of one hour I noticed a big increase in the height of the water in the boilers, so for the second time the matter was reported to the chief engineer.

After a short consultation we decided to stop the ship and open up the main condenser. In another half hour the ship

was stopped and before long the doors were off the condenser and the sea water was run from it into the bilges. The condenser now being dry on the seaside the trouble was at once seen and made good. The defects we found were as follows:

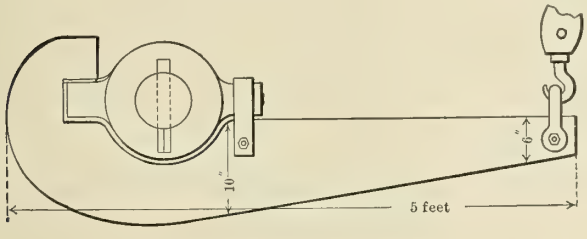
In the first place it must be known that there were two condensers and all the defects I now write of were found in the fore condenser in the fore end of it. Brass stays were passed through the condenser and adjusted at each end by a ⅞-inch brass bolt which went through a fitted hole in the tube plate and screwed into the end of the stay. Several of these stays and bolts were fitted thus to brace the condenser. It was one of these stays which was giving the main trouble. One of the brass bolts had snapped off flush with the stay end, thus allowing a large quantity of salt water to mix with the fresh. We also found that the top half of the tube plate was cracked for about 2 feet of its length vertically. We also found on further examination that about fifteen of the tubes were leaking very badly. These we plugged with hard wooden plugs. We then plugged the crack in the tube plate with hard wooden wedges. This done we were not long in getting the doors on and once more resuming our voyage to Liverpool. When we reached this port we had the defects made good, and sailed again a week later for New York.

Francis J. Nolan.

A Loose Propeller and Loaded Ship.

A short while ago, immediately on my arrival at Monte Video, a launch came alongside the steamer of which I was chief engineer and I was requested by a gentleman to accompany him on board another steamer and act as one of three surveyors to look over the machinery of that steamer. On arrival on board I was informed that the vessel was from the west coast of South America, was deep loaded and had put in with a loose propeller.

After having the entries in the log read to us, we decided that the first thing to do was to send a diver down to get the size of the nut and to see how much it had slacked back. When the diver returned from below he had the exact size and shape of the nut, taken by bending a piece of wire round it; he also informed us that the nut had slacked back about ⅜ inch and was bearing hard against the split pin. The next thing we decided to do was to have a long and substantial spanner made, to the end of which we could make fast a pair of 10-ton blocks, the other end of the blocks being made fast to a boom put out from the deck. The accompanying sketch



SPANNER AND CLIP IN PLACE.

gives the shape of the spanner and the clip arrangement for keeping it in place on the nut; the spanner was made out of 1½-inch steel plate.

The manner of tightening up the nut was as follows: As much as possible was taken up on the blocks, then the engines were turned ahead with the turning engine, the rope blocks being slacked off and the spanner end allowed to drop down below the horizontal; the turning engine was then stopped and another pull taken on the blocks, the same process being repeated until the nut was tightened hard up. The diver then went down again, removed the iron clip that held the spanner in position, then by turning the engines astern the spanner slipped off the nut and was hove on board by the blocks. We then had a ⅜-inch washer made and placed between the nut and the pin, so that it couldn't possibly slack back again.

After the job was completed, we three surveyors went on board again and gave the engines a good testing at full speed ahead and astern alternately, and, although I went to the end of the tunnel and listened, I could not hear the slightest sound of slackness. To make doubly sure we sent the diver down again with a heavy hammer and instructions to try the nut; he returned and reported it to be thoroughly secure. We then gave the captain a certificate of seaworthiness.

The greatest difficulty with the job was that the diver was not able to see anything because the water was very dirty, consequently he had to do everything by feeling, and I consider that we saved the steamer a great deal of expense, as other surveyors had refused to give a certificate until the propeller had been sighted, and as she was loaded with over 6,000 tons of cargo and drawing 23 feet of water, it would have been a costly business to discharge that to tip her, or put her into dry dock.

La Plata, Argentina. Marinero.

How a Ship Was Sunk by a Propeller.

We were on a voyage from Calcutta to Liverpool and London with a cargo of tea. We had come through the eighty-seven miles of the Suez Canal without mishap, and were just coming out of the Port Said entrance to the canal when a small collier of about two thousand tons, which we afterwards learned was on her way to meet the Russian Baltic fleet in the Red Sea and coal them, dropped anchor right in the fairway of the entrance. Our ship had a speedway on her estimated at three miles per hour. In swinging to avoid the coal ship her midship section came right under our port quarter, and we came into violent contact with one another. Our propeller, which was revolving at the time at 25 revolutions per minute, crashed through her side and opened up a huge hole into her hold where the cargo of coal was stowed.

At the time of the accident I happened to be down below, working the engines according to orders from the bridge. Without any warning the engines pulled up dead with a most fearful shake and a long groan; the latter came from the tunnel and, as we found out afterwards, was the noise made by the propeller tearing through the other ship's side. After the first shock the engines made a quick quarter of a turn. This was the second blade doing its work. Steam having been shut off the main engines, this second movement was caused by the steam which remained in the engines and by a leaky throttle. Our propeller had four blades made of manganese bronze and bolted on to a cast steel boss.

Tow boats got hold of the smaller ship and eventually, after a lot of pulling, managed to pull her off our propeller. However, before they managed to get her into shallow water she sank in a depth of water which covered the top of her smoke stack. We found on examination that we were minus a blade and a half of our propeller. In this crippled state we made our way to London and thence on to Liverpool, taking two and a half days longer on the whole run. When we arrived at Liverpool we had two new blades fitted and a week afterwards we were once more on our way to Calcutta.

F. J. Nolan.

The Naval Appropriation Bill passed the House of Representatives on April 8. This bill authorizes the construction of two first-class battleships, two fleet colliers and four submarines. It is stipulated that the battleships and colliers must be constructed by firms observing the eight-hour law. The total amount carried by the bill is $128,037,602 (£26,300,000).

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The Argentine Dreadnoughts.

Wide-spread interest has been manifested by both the technical and daily press in the contract for the two Argentine Dreadnoughts recently placed in America, and comment has been rife both regarding the conditions which enabled American shipbuilders to underbid the world for this contract and also concerning the details of the successful designs. Through information received from our special correspondent in Argentina we are able to furnish our readers with many details regarding both the contract and the ships themselves, some of which we believe have not hitherto been published.

In the first place, as far as the cost of warship construction is concerned, it is true that the cost of hull construction in the United States is approximately fifty percent greater than that in England, the lowest market in the world for this work. On the other hand, armor plate and ordnance can be manufactured in the United States at a lower figure than in any other country. Consequently, the total cost of warship construction can be made as low, if not lower, than elsewhere, and it was due to the co-operation of the shipbuilders and the armor plate makers, as well as to the excellence of the designs submitted and the satisfactory performance of the American type of turbine, that the contract was placed in America.

The placing of this contract by a nation which has added nothing to its naval strength during the last twelve years is significant, as indicating the remarkable development of the Argentine Republic since her awakening a few years ago. It also indicates that the time has arrived when naval construction is assuming a definite basis, which is likely to endure for some time to come; that is, the basis of a modern navy has now become the Dreadnought type of battleship, and nations which have been waiting during the transition period of naval construction can now proceed with more or less certainty to develop their fleets, using the Dreadnought type as the capital ship.

Eighteen firms of various nationalities sent in tenders for the construction of these ships, and these were carefully examined in London by a specially appointed committee, assisted by several well-known naval engineers. As a result of its deliberations the committee reduced the number of bidders to six, from whom the final selection was made. The following were the firms whose tenders were retained, together with particulars of the displacement, speed and price per ton named in the tenders:

Name of firm.	Displacement in tons.	Speed in knots.	Price per ton.	
Blohm & Voss (Germany).....	24,900	22	$430.02	£88.3
Blohm & Voss (Germany).....	25,900	22.5	432.94	88.9
Blohm & Voss (Germany).....	26,900	25	426.61	87.6
Forges et Chantiers (France).....	27,840	22	412.98	84.8
Forges et Chantiers (France).....	25,170	22	425.64	87.4
Armstrong & Vickers (England)..	29,060	24	415.41	85.3
Armstrong & Vickers (England)..	28,040	22.75	425.15	87.3
Armstrong & Vickers (England)..	27,840	23	422.23	86.7
Ausaldo (Italy)	25,600	22	418.33	85.9
Fore River, also New York Shipbuilding Co. (U. S. A.).....	27,940	22.5	381.32	78.3

It will be seen from the above figures that the lowest of the three tenders submitted by the English company was almost equal in tonnage and speed to that of the American concern, but that the English price was $38.96 (£8) more per ton. If the Argentine government had accepted the English tender, this would have meant that each ship would have cost $1,138,362.50 (£233,750) more.

The information and full data sent to Argentina by the committee in London were carefully considered by the Minister of Marine, at Buenos Aires, assisted by the leading naval authorities there, and after careful investigation they advised the President of the Republic to give the order to the American company. The work of the construction of the two Dreadnoughts was therefore placed in the hands of the Fore River Shipbuilding Company, with the provision that one of the hulls should be built by the New York Shipbuilding Company, provided the former firm accepted full responsibility as to the standard of work, etc.

The contract for the armor and ordnance went to

the Bethlehem Steel Company, and, as stated above, it was due to the co-operation of this company with the shipbuilders that the American concern was able to quote such a favorable price for the completed vessels. A portion of the contract goes to English firms, however, as the boilers, which are of the Babcock & Wilcox type, and also the pumps will be built in England, and brought into America under bond to be worked into the ships. Each ship will cost $10,654,108.74 (£2,187,702), or the two together will cost $21,308,217.48 (£4,375,404). The stipulated time to be occupied by the construction is two years for one ship, and twenty-seven months for the other.

In design these ships represent the highest development of modern Dreadnoughts. The displacement at the normal draft of 27 feet is calculated at nearly 28,000 tons, but this will be increased to 30,000 tons when the vessels are fully equipped for war, the draft being in that case 30 feet. They will be 604 feet long, with a beam of 96 feet, and they will be driven by Curtis turbines, aggregating 39,500 horsepower, which are designed to give the ships a speed of 22.5 knots. The turbines will be located in three separate compartments, and the boilers in six compartments divided into two groups. The boilers will be equipped for both coal and oil fuel. The provision for burning liquid fuel was stipulated by the Argentine government largely on account of the recent discovery of large quantities of petroleum in the southern part of Argentina. The capacity of the coal bunkers will be such as to enable each vessel to steam 10,200 miles at 11 knots, 7,200 miles at 15 knots, and 3,600 miles at 22.5 knots. The capacity of the oil tanks will be such that the radius of action with oil will be about one-third that on coal.

The armament will consist of twelve 12-inch guns, 50 calibers in length, placed in pairs in six turrets, two forward and two aft, arranged at different levels, so that the guns in one turret can fire over the other, and two placed *en echelon* amidships, both, however, being free to fire on either broadside. The minimum height of the guns in the forward turrets above the waterline is 25 feet, and that of those in the central turrets 22 feet, while the after turret located on the poop deck is 17 feet above the waterline. These heights have been found by experience to insure that none of the guns will be forced out of action in case of heavy weather, as has been found to be the case in some earlier warship designs.

A glance at the inboard profile of these ships shows a deck practically free from superstructure of any kind, the spar deck extending from the bow for about 450 feet aft, the only obstructions, besides the turrets, being two funnels, a lattice fire control mast, and the conning towers and bridge.

The secondary battery will consist of twelve 6-inch guns, 50 calibers in length, mounted on the main deck amidships at a height of 16½ feet above the waterline. There are also twelve 4-inch guns of 50 calibers length, placed in commanding positions for protection against torpedo attack. The principal details of the armament are as follows:

	12-inch.	6-inch.	4-inch.
Weight of the projectile.....	867 lbs.	105 lbs.	33 lbs.
Initial velocity per second.....	3,000 feet	3,000 feet	3,000 feet
Force at discharge.....	16,890 tons	2,028 tons	640 tons
Speed of firing per minute.....	2	4 to 8	12

Compared with the latest British and American designs, it is evident that these vessels will be the most powerfully armed ships afloat, and that, due to the excellent disposition of the guns, they offer a maximum bow and stern fire, as well as broadside discharge. The placing of the midship turrets *en echelon* is a practice which could be followed with advantage in American warships.

While the protection of a battleship is a matter of considerable dispute among the highest authorities, there is no indication in the design of the Argentine Dreadnoughts of sacrificing any advantage which may obtain with the use of heavy armor, and, in addition, there is a distinct advance in the matter of hull construction to resist torpedo attack. All the machinery and the magazines are at a distance of not less than 12 feet from the bottom of the hull, which is constructed with an extra shell and armored with nickel steel. This construction, coupled with a minute subdivision of the hull, probably represents the most distinct advance in protective features which has yet been introduced in modern warship design.

The main armor belt is 12 inches thick amidships, tapering fore and aft to 6 inches and 5 inches, respectively. This belt extends 6 feet above the waterline and 3 feet below it, and is surmounted by a belt 8 inches thick, extending to the upper deck, and above this by a belt of 6-inch armor, which forms the protection for the secondary battery. The 12-inch turrets are protected by armor, varying in thickness from 7 inches to 12 inches, according to position, while the two conning towers are protected by 12-inch armor. Special care has been used in working out the protection of the machinery, boilers and stacks. A system of transverse screens and gratings of nickel steel has been introduced and the two funnels are each protected by 1½-inch steel plate for a height of 15 feet above the spar deck

To aid in economy of operation, auxiliary boilers capable of furnishing sufficient power to light the ship, operate the fire and sanitary pumps, and the cranes for taking on stores, etc., will be fitted in order to obviate the necessity of keeping the main boilers under steam when in port. It is stated that this auxiliary machinery is so arranged that it can easily be dismounted and sent ashore if considered desirable in time of warfare.

The building of the ships in the United States will be supervised by a special commission from Argentina, presided over by a rear admiral of the Argentine navy, the immediate work of inspection being in charge of three sub-committees designated for different duties.

Progress of Naval Vessels.

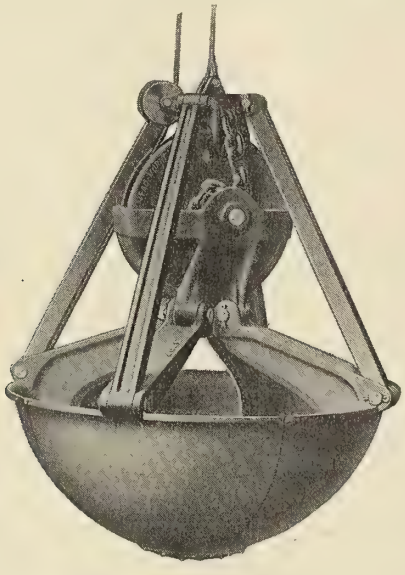
The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		Mch. 1.	Apl. 1.
BATTLESHIPS.					
North Dakota	20,000	21	Fore River Shipbuilding Co..	99.1	99.7
Florida	20,000	20¾	Navy Yard, New York.....	55.2	59.0
Utah	20,000	20¾	New York Shipbuilding Co...	65.2	68.5
Arkansas ...	26,000	20½	New York Shipbuilding Co...	12.5	15.7
Wyoming ..	26,000	20½	Wm. Cramp Sons.....	16.9	19.5
TORPEDO-BOAT DESTROYERS.					
Paulding ...	742	29½	Bath Iron Works.....	71.8	81.1
Drayton	742	29½	Bath Iron Works.....	67.4	73.6
Roe	742	29½	Newp't News Shipbuilding Co.	77.2	81.4
Terry	742	29½	Newp't News Shipbuilding Co.	76.6	79.9
Perkins	742	29½	Fore River Shipbuilding Co..	65.8	67.7
Sterrett	742	29½	Fore River Shipbuilding Co..	65.6	66.9
McCall	742	29½	New York Shipbuilding Co..	53.4	56.8
Burrows	742	29½	New York Shipbuilding Co..	53.4	56.2
Warrington..	742	29½	Wm. Cramp & Sons.....	62.7	65.5
Mayrant	742	29½	Wm. Cramp & Sons.....	64.9	69.7
Monaghan ..	...	..	Newp't News Shipbuilding Co.	14.8	17.7
Trippe	...	..	Bath Iron Works.....	22.9	25.3
Walke	...	..	Fore River Shipbuilding Co..	14.0	19.2
Ammen	...	..	Fore River Shipbuilding Co..	14.6	19.4
Patterson ...	...	..	Wm. Cramp & Sons.....	10.7	12.1
SUBMARINE TORPEDO BOATS.					
Salmon	...	..	Fore River Shipbuilding Co..	91.0	91.7
Seal	...	..	Newp't News Shipbuilding Co.	45.4	47.1
Carp	...	..	Union Iron Works.....	43.3	45.7
Barracuda ..	...	..	Union Iron Works.....	43.1	46.1
Pickerel	...	..	The Moran Co.....	40.25	43.3
Skate	...	..	The Moran Co.....	40.25	43.3
Skipjack	...	..	Fore River Shipbuilding Co..	31.3	35.3
Sturgeon ...	...	..	Fore River Shipbuilding Co..	30.9	34.7
Tuna	...	..	Newp't News Shipbuilding Co.	19.8	21.2
Thrasher ...	...	..	Wm. Cramp & Sons.....	3.1	4.3

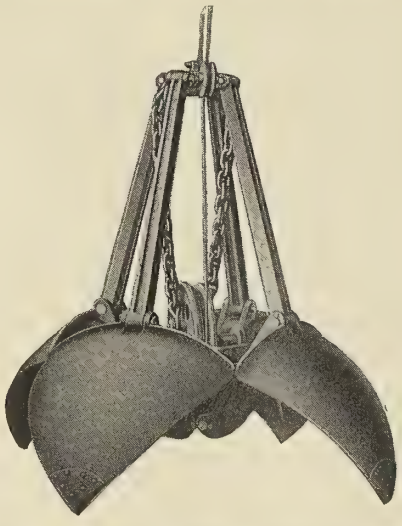
ENGINEERING SPECIALTIES.

An Efficient Orange Peel Grab Bucket.

A useful and efficient grab bucket for use in connection with dredging and digging operations is manufactured by the Mead-Morrison Manufacturing Company, Cambridge, Mass. This bucket, which is illustrated both open and closed, is constructed of a small number of parts, and rivets, bolts and such



parts as are liable to become loose have been eliminated. The closing chain is a standard crane chain and not a chain of special construction, and therefore the chain can be readily renewed and repaired by any good blacksmith. The closing wheel about which this chain winds is bronze bushed, provided with an internal oil reservoir and mounted on a stationary shaft carried in the lower pivot head, this construction affording liberal bearing and wearing surface in place of the small and inadequate surface provided in some other designs. The closing wheel around which the rope winds is cast iron, forced on a cast steel sleeve, about which the chain runs, the sleeve being the part mentioned above, which is bronze bushed. It is claimed that the strain in both strands of the closing chain is automatically equalized at all times by the passing of the closing chain over a saddle in the top pivot head instead



of using two independent chains independently fastened. All parts of the grab except the closing wheel on which the closing rope runs are steel castings, and the tips or points for the shell segments or blades are made of manganese steel. These grabs are regularly bronze bushed throughout.

The McNab Marine Register and Indicator.

This instrument is designed to show in any part of the vessel where it is installed the exact manner in which the main engines are running, whether ahead, astern, at slow or full speed, etc. It has been evolved to eliminate the human risk which always exists where orders must be passed along from one to another by indirect methods of communication. The

instrument is very simple, consisting merely of a tube of iron with an air agitator at one end at the engine and a small piston at the other. The agitation of the air in this tube by the revolution of the shaft sends the piston up and down and moves the small indicator piston and register up and down. The engine of the ship cannot move without operating the agitator. The latter operates the small piston at the ahead or astern dial, causing the piston in the dial to rise and fall at each revolution. Its action begins with the first revolution of the propeller and continues as long as the engines are in operation, and shows the speed at which the engines are turn-

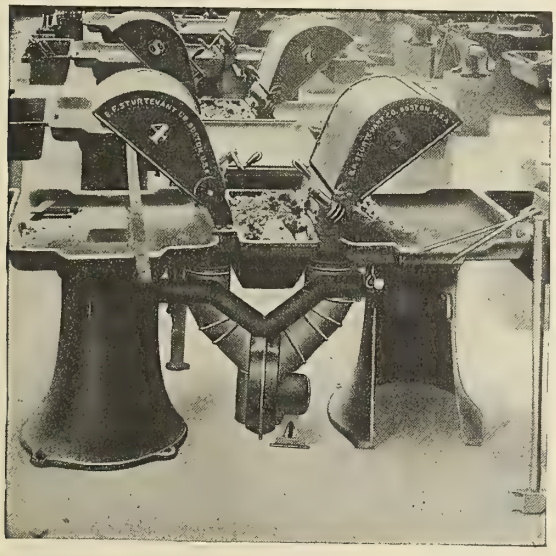
ing. The indicators can be placed at various points throughout the ship, wherever advantageous, and it is claimed that excellent results have been obtained even when the instrument was installed as far away from the engine as 1,000 feet. This device is manufactured by the McNab Indicator Company, Bridgeport, Conn.

Zynkara.

Zynkara is a solution of metallic zinc designed for use in marine boilers to supersede the use of metallic zinc plates to prevent pitting and corrosion. Since Zynkara is applied in solution it immediately distributes itself throughout all parts of the boiler, and thus is equally effective on each part of the boiler surface; whereas when metallic zinc plates are used they only give adequate protection to neighboring parts of the boiler. It is claimed that this compound reacts directly on the feed water of the boiler, preventing any chemical, and therefore any magnetic, action in the boiler, also destroying all oily matters which pass over from the cylinders, therefore preventing the deposit of such impurities on the furnace crowns and other dangerous parts of the boiler. It is also claimed to remove scale from boiler surfaces and replace it with a thin shell-like enamel or coating which is continually being thrown off and again being replaced, thus reducing time and cost of cleaning boilers to a minimum. Since Zynkara can be applied to a boiler daily while the boiler is in operation the engineer can always be sure that his boiler is protected; whereas, if metallic zinc plates are used they can only be renewed in port and may have become so corroded and covered with scale before port is reached as to have become practically useless. The compound is manufactured by the Zinkara Company, Ltd., Newcastle-on-Tyne.

Sturtevant Electric Forge Blower.

The Sturtevant electric forge blower, manufactured by the B. F. Sturtevant Company, Hyde Park, Mass., is composed of a pressure fan of the multi-vane type inclosed in a pressed steel plate casing driven by a direct-connected electric motor built to operate from electric lighting circuits. The particular features of this blower set are compactness and high efficiency,



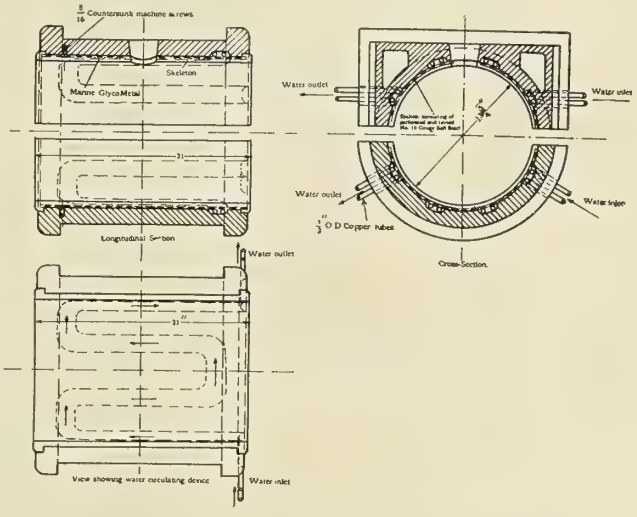
which it is claimed have been secured owing to the use of the multi-vane type of fan wheel. The principle on which this wheel is constructed is that of using many narrow blades in conjunction with a large air inlet. The illustration shows the installation of one of these sets connected to two forges. It is claimed that the same advantages can be gained by using individual blowers in forge work as can be obtained by using individual motors in driving machine tools, etc.

The blowing set weighs 35 pounds, measures 14½ inches from the floor to the top of the fan case, and 10 inches from the inlet of the fan to the outside end of the motor shaft. It can be installed to suit the requirements of individual cases as to location, etc.

The company claims that with this blower connected to a forge with a tuyere area of 1.5 square inches, a 2-inch, round, soft steel bar can be brought to a welding heat in 4 minutes and a 1-inch bar in 2½ minutes.

Glyco Bearing Metal.

Glyco is a scientifically-made bearing metal, which is designed to replace the tin white metal composition commonly used for lining bearings. Bearings lined with tin and bronze alloys have been satisfactory practically, but they have the commercial drawback of being far more expensive than a lead base alloy, and are subject to violent fluctuations in price according to the market. It was in the search for a lead base alloy having equal or superior properties to tin base metal and, at the same time, the advantage of cheapness, that Glyco was invented. Tests of this metal in comparison with a high tin



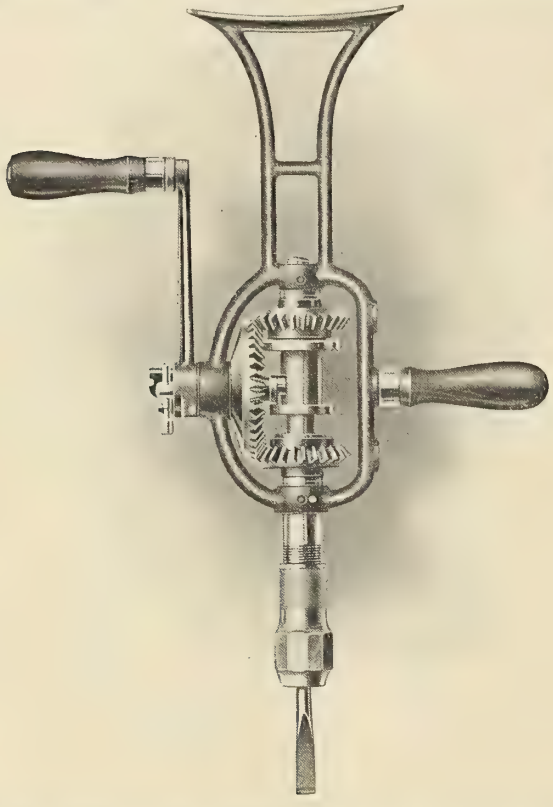
alloy have shown that both metals stood about the same pressure per square inch, namely, up to 700 pounds in duration tests and 900 to 1,000 pounds in short runs. Glyco was shown to have a superior and very high uniformity and homogeneity. It also gave a 15 to 30 percent lower friction curve than the high tin alloy. The tests also showed that in case of lack of oil Glyco will not melt out quickly, as does the tin alloy, but will only stick to the journal without damaging it; and, further, that this occurs at a higher temperature than that which causes the melting of the high tin alloy.

The illustration shows the main bearing of a marine engine shaft equipped with Glyco metal and the Glyco patented skeleton construction. The skeleton consists of a No. 10 perforated and tinned soft steel sheet. If desired the skeleton may be made out of bronze instead of soft steel. A special feature of this bearing is the water-cooling device. The cored channels and water-jackets generally used are done away with, and a pair of copper tubes, ½ inch outside diameter, are inserted in grooves in the cast iron bearing surface. The skeleton protects the tube from possible injury. When the Glyco is poured in, the tubes are firmly embedded in the liner, and the cooling device is thus brought near the surface bearing.

Glyco metal is being placed on the market by Joseph T. Ryerson & Son, Chicago.

Ashcroft Combination Valve Grinder.

The Ashcroft combination valve grinder has been designed to meet the demand for a handy, light, compact and durable tool for service on automobiles, motor boats, etc. Leaky valves on a gas engine mean poor compression, inability to start the motor on a spark, greater fuel consumption and loss of power and efficiency. The necessity for having an efficient tool to



grind valves is therefore apparent, and it is claimed that this grinder, because of its unique action, insures a means of grinding valve seats smoothly and absolutely true. The action peculiar to this grinder is an oscillating one, with the arc of oscillation gradually advancing to the right, which prevents the cutting of grooves. The tool can also be used as a breast drill or ratchet. It is being marketed by Manning, Maxwell & Moore, 85 Liberty street, New York.

Apprenticeship Certificates.

Manufacturers are always looking out for some means of awakening ambition and inspiring better and more faithful service on the part of their employees, especially of the younger men who are trying to learn the business. One of the best aids for this purpose which has recently come to our attention is the apprenticeship certificate given by the Bantam Anti-Friction Company, Bantam, Conn., makers of ball and roller bearings of all types, to the boys in their shops who have served their full three and one-half years' apprenticeship. The certificate states that "The recipient has duly served his full term as an apprentice in the machine shops of the above company, and has had all instructions possible in the operation of lathes, milling machines, drills, shapers, grinders, tool making, bench work and other practice usually found in machine-shop work. We can safely recommend him as a good and worthy machinist, reliable and conscientious in all of his work."

It is needless to say that a certificate of the above character, signed by the president and manager of the company, is a thing to be highly valued by the apprentice, and the company states that it has proved a very good incentive for work and something which the young men appreciate very much.

The Star Condenser Packing Tool.

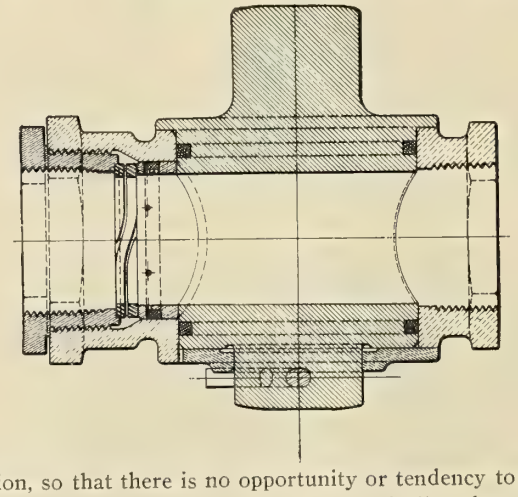
A marked reduction in the time required for the packing of condenser tubes may be made by the use of the tool shown in the illustration. In its construction the straight portion of the pointed center which telescopes in the body of the tool is of the same diameter as the condenser tube. When using the tool one end of the packing which has been cut to the proper length to fill the stuffing-box is pushed to the bottom of the box and given about one-half turn around the tube. The tool is then placed against the end of the tube, the helical spring allowing the outer shell to slide to the bottom of the box. The

free end of the packing is then passed under the lip of the outer shell, and the tool is turned by a breast drill, brace or cross handle, and the packing automatically packs itself in the box.

On the United States cruiser *Pennsylvania* 1,200 tube ends were packed in five and one-half hours. Condensers have been packed with this tool and a water pressure of 5 feet head put on before the glands were screwed up without showing a leak. It is made for all sizes of tubes by Matteson & Drake, 24-26 Stone street, New York City.

The Caskey Compressed Air Valve.

The illustration shows a valve which was originally designed for hydraulic use and developed under a pressure of 10,000 pounds per square inch. This valve has been found to be equally effective at low pressures and has been adapted to compressed air pipe lines. The valve has a straight-through opening equal to the area of the hose with no change of



direction, so that there is no opportunity or tendency to choke. An adjustable sealing plug, which automatically takes up any slight wear, serves to keep the valve tight under all pressures. As the packing is not exposed it is claimed to be practically indestructible. These valves are made of manganese bronze in all sizes, from ¼ inch to 3 inches, by the Caskey Valve Company, 99 John street, New York.

Howdens' Forced Draft System on Dredgers.

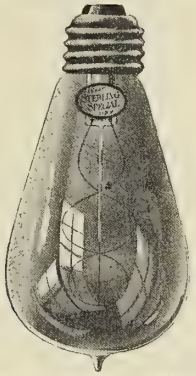
One factor which it is claimed has had much to do in bringing about the unusual results in economy and efficiency obtained with the two Bombay reclamation dredgers *Jinga* and *Kalu*, descriptions of which can be found in the May, 1909, and current issues of International Marine Engineering, is the installation of Howdens' patent system of forced draft in connection with the boilers. This system of forced draft has been widely adopted by the leading steamship companies of the

world for a good many years, but it has not been adopted to any extent in dredgers. It is claimed that the unusual advantages which this system entails in the way of increased economy of fuel and increased steaming power of the boilers would be even more marked in the case of dredgers where the load is fluctuating and where specially heavy demands for steam are occasionaly required. This system is installed by James Howden & Company, Glasgow.

Effect of Wireless Induction upon Lamps.

A recent complication in the electric lighting of ships was introduced with the wireless telegraph. It was observed that the high induction of the wireless had a serious effect upon the lamp renewal expense of the Graham & Morton Transportation Company, and extensive tests were made by them to find a lamp for service with this high induction.

Twelve different makes of lamps were tested, among them the Sterling Special, a spiral filament type, made by the Sterling Electrical Manufacturing Company of Warren, Ohio. Three lamps of each make were tested, each being subjected



to the high induction for one hour. Eleven of the twelve types of lamps tested failed to withstand this severe test. The filament of each type would spread, hit the glass and blow out. At the end of the test it is claimed that all three of the Sterling special lamps were burning and were in perfect condition. On board ship the Sterling special lamp has now, besides the advantage of 16 candle power in all directions, the additional advantage above referred to.

PERSONAL.

Frank McMurdie, superintendent of the American Blower Company's Detroit plants since about 1894, has resigned, his resignation taking effect March 31. After a short pleasure trip he will take the general superintendency of the Clarage Foundry & Manufacturing Company, of Kalamazoo. Mr. McMurdie was one of the oldest employees of the American Blower Company, having entered their employ in 1883.

Walter M. McFarland, who has been associated with the Westinghouse Electric & Manufacturing Company since Jan. 1, 1899, has resigned to accept an official position with the Babcock & Wilcox Company. Mr. McFarland has occupied the office of acting vice-president for the Westinghouse Electric & Manufacturing Company for a period extending over ten years. In this capacity he has had official supervision of the large contracts of the company, as well as being the advisory head in all the co-operative movements of the company with the associated Westinghouse companies involving literature, advertising and exhibition work. Mr. McFarland was born in Washington, D. C., in 1859. His education was received in the public schools of Washington, the preparatory department of Columbia University and the United States Naval Academy. He entered the latter institution as a cadet engineer in 1875, and in 1879 was graduated second in his class. In 1881 he was commissioned as assistant engineer; in 1891 as past assistant engineer, and in 1898 as chief engineer. After having had wide experience in sea service, he was detailed for service in the Bureau of Steam Engineering in 1882. From 1883 to 1885 he was detailed from the navy as assistant professor of mechanical engineering at Cornell University, and during the years 1885 and 1886 he was occupied with the inspection of machinery then building, and with work on preliminary design for proposed vessels. From 1889 to 1894 he was again attached to the Bureau of Steam Engineering. This experience, together with his experience in the affairs of the Westinghouse Electric & Manufacturing Company, admirably fit him for the duties which his connection with the Babcock & Wilcox Company will impose upon him. Mr. McFarland was vice-president of the American Society of Mechanical Engineers in the year 1907, and at the present time is vice-president of the Society of Naval Architects and Marine Engineers.

TECHNICAL PUBLICATIONS.

The Directory of Shipowners, Shipbuilders and Marine Engineers, 1910. Size, 8½ by 5½ inches. Pages, 792. London, 1910: The Directory Publishing Company, Ltd.

This useful directory has now reached its eighth year of publication, and the present edition has been thoroughly revised and brought up to date; an addition of some fifty pages being made. The publishers have devoted an immense amount of care in making the particulars given as accurate and up to date as possible, and also in arranging the book to facilitate reference to any vessel, owner or builder, with a minimum of trouble. By means of this Directory one can instantly secure particulars of the output, personnel and vessels of any shipbuilder or marine engineer; the personnel, fleet and important details concerning the vessels of the shipowners. The personal and boat index enable instant reference to the leading men in the shipowning and building worlds, and also their vessels. The usefulness of the book is undoubted, and we imagine it to be indispensable in a large number of offices.

Marine Engine Indicating. By C. S. Linch. Size, 6 by 9 inches. Pages, 163. Numerous illustrations and supplementary folding plates. Boston, 1910: American Steam Gauge & Valve Manufacturing Company. Price, $2.

This book will be heartily welcomed by marine enginees, as it is a thoroughly practical book, written exclusively for marine work. It is not filled with page after page of theoretical mathematical work, but has reduced the theoretical consideration to the smallest practical limits, and has given page after page of practical data taken from various marine engines under almost every condition of service. It is true that the book is incomplete in that it considers only one type of indicator, and that the one manufactured by the publishers of the book, and to this extent it is, of course, in the nature of a catalogue.

The space taken up by the description of the instrument and method of handling it is, however, comparatively small, and is confined to the first chapter. The remaining three chapters take up, respectively, the computation and combination of diagrams, modern marine engine practice, from a single-cylinder to a four-cylinder, triple-expansion engine, and the construction and use of valve diagrams. Nearly 75 pages are taken up with reproductions of actual cards with the tabulated data obtained from them. This series of diagrams is representative of modern marine engine practice, and the data are sufficiently complete to enable a thorough analysis to be made. Some valuable plates of large size are also included in the book, which show the construction of valve diagrams, combined indicator diagrams as well as a sectional drawing and the general arrangement of a triple-expansion engine showing the indicator reducing motion, etc. Tables of hyperbolic and common logarithms of numbers from 1 to 1,000 are also included.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

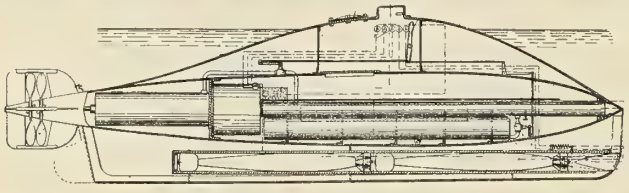
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

946,659. DEPTH-REGULATING MECHANISM FOR MOVING VESSELS. GREGORY CALDWELL DAVISON, OF QUINCY, MASS.

Claim 1.—A depth regulating mechanism for moving vessels having a movable element subjected to the pressure of the water of submergence, in combination with a float displacing a heavy liquid and connected to move the movable element against the said pressure, a depth-controlling rudder, and connections from the movable element to the rudder. Four claims.

946,944. TORPEDO BOAT. HUDSON MAXIM, OF NEW YORK, N. Y.

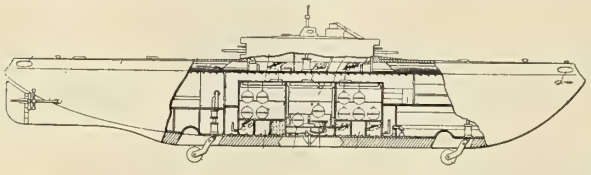
Claim 1.—The herein described process of launching automobile torpedoes from a tube within which they are immersed in water, which consists in utilizing the combined action of the propellers of the same



and the expansive force of the escaping motor fluid acting upon the torpedoes at their rear to impart the launching movement thereto. Four claims.

947,921. SUBMARINE VESSEL. SIMON LAKE, OF BRIDGEPORT, CONN.

Claim 1.—In a submarine vessel, a hull, and an air-tight compartment arranged centrally therein and having partitions to divide it into storage compartments and an intermediate diving or mine-planting compartment, the center of volume of which is arranged in vertical alinement with



the center of gravity and center of buoyancy of the vessel, a launching tube arranged and opening within said diving or mine-planting compartment, and means to supply compressed air to said diving or mine-planting compartment to exclude the water therefrom during the time said tube is open. Fourteen claims.

947,230. MOORING FOR MINE-ANCHORS, ETC. CHARLES R. GABRIEL, OF NEW YORK, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

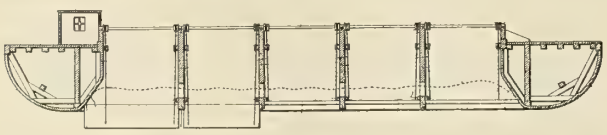
Claim 1.—The combination with a buoyant mine, an anchor therefor, and a mooring cable, of means applied to the anchor for engaging the cable to connect the anchor and mine through a required length of cable, means for operating said engaging means before the descending anchor strikes bottom, and means for rendering said operating means inoperative until the anchor is submerged to a prescribed depth. Fifteen claims.

947,624. DREDGING APPARATUS. JOHN OSTERVOLD, OF WESTPORT, ORE., ASSIGNOR OF ONE-HALF TO JOSEPH R. BURKE, OF CATHLAMET, WASH.

Claim 1.—In dredging apparatus, spaced supports, a series of floats arranged between said supports, an endless, flexible band arranged between said supports, means for operating said band, pulleys for guiding the upper run of said band, and connections between the pulleys and said floats, the lower run of said band being arranged to move in contact with the obstruction to be removed. Three claims.

950,242. DUMPING SCOW. WILLIAM W. ROBINSON, OF PHILADELPHIA, PA., ASSIGNOR OF ONE-HALF TO JOHN H. MATHIS, OF PRIMOS, PA.

Claim 3.—A scow having a central opening divided into a plurality of compartments connected below the water line for no load; the forward



wall of the forward compartment being forwardly inclined toward the bottom of the scow, and each of said compartments being provided with a swinging bottom. Four claims.

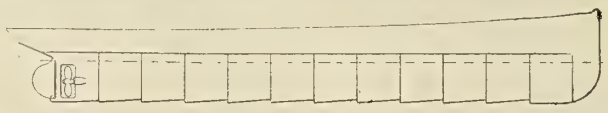
950,860. SHIP CONSTRUCTION. ABEL L. MOONEY, OF SOUTH ORANGE, N. J.

Claim 7.—In a device for relieving a ship's hull from skin-friction, means for interposing a stratum of air between the bottom of said hull and the water and means for equalizing the pressure of air throughout said bottom. Fourteen claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

1,447. REDUCING THE WATER FRICTION OF SHIPS AND BOATS. T. O. SMITH, SOUTHAMPTON.

It is known that if, by external means, together with the motion of the vessel, air can be introduced between the skin of the vessel and the water normally in contact with it there will be a consequent reduction of the resistance due to fluid friction and a corresponding increase of speed. This invention consists in arranging the plating or the planking in conjunction with the framing so that the outer surface, from a point



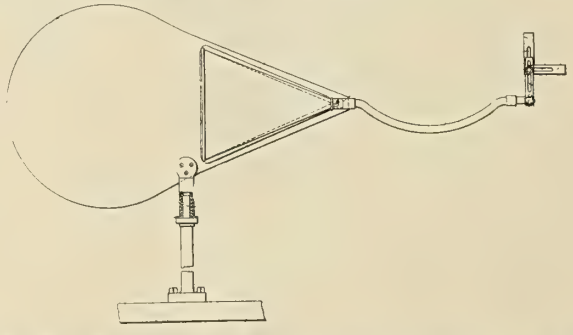
just above the usual line of flotation downwards, presents to the water a series of inclined surfaces with corresponding notches or steps arranged at right angles. At a low speed the water will eddy round the steps. At a higher speed the cavitation behind the steps induces air to descend the notch from above the water line and take the place of the water, which ceases to form an eddy and flows more evenly from plane to plane.

3,084.—ANCHORS. H. G. TAYLOR, WOLVERHAMPTON.

By making the anchor as shown, that is, with the two arms and the wing plate separately from one another to form the head, and secured to the shank by the wing plate and wedge, the parts can very readily be forged or made as sound steel castings, and there is very little work in fitting them together.

4,152. AN APPARATUS FOR LOCATING SOUNDS IN THE DARK OR IN FOGGY WEATHER. H. A. J. RANG, NEWCASTLE-ON-TYNE.

The instrument comprises a pear-shaped plane or interceptor having on each side a trumpet and transmitting pipe and rotatively mounted on a standard. The pipes at their other ends have resonance boxes secured to a frame adapted to hold the boxes to the ears. When it is



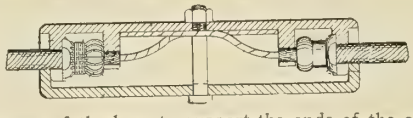
desired to locate a sound the eyes are shut to sharpen the sense of hearing and the apparatus slowly rotated until the sounds are of equal volume. This determines the position of the source, which will be in line with the intercepting part.

9,053. APPARATUS FOR CONVEYING DIRECTIONS FROM THE LAND TO SHIPS IN RIVERS, HARBORS AND THE LIKE DURING FOGGY WEATHER. J. ORLAY, TEMSCHE, BELGIUM.

The invention has for its object to facilitate the navigation of ships when passing out of rivers, harbors, etc., during foggy weather, and comprises a rope or the like carried, over a pulley arranged on the ship, to a bicycle, automobile, etc., running near the course at the same speed as the ship, and reels or drums carried by the vehicle, through the rotation of which in the one or the other direction the cable is wound off one drum and on to the other, so that directions as to the course to be followed may be constantly conveyed from the land to the ship.

10,052. MEANS FOR JOINING THE ENDS OF SUBMARINE OR OTHER TELEGRAPHIC AND LIKE CABLES. J. F. DYSON, MANCHESTER.

The invention relates to a device by which the ends of the cable can be easily and quickly prepared for joining and be held securely in position during the joining on at other times. The device is made in two parts, one, acting as a base and the other as a cover, upstanding slotted



lugs forming part of the base to support the ends of the cable. Flanged collars are located between the lugs and are mounted on the cables, and to these the armouring can be secured, such collars preventing longitudinal displacement of the cable ends and also rotary movement.

11,581. RESERVE PROPELLERS FOR STEAM AND OTHER POWER-DRIVEN SHIPS. C. WILLSON, GREAT GRIMSBY.

The invention consists mainly in the arrangement of a water-tight chamber in any suitable position adjacent to the main propeller and surrounding the propeller shaft so that a reserve propeller may be secured to the shaft when desired, the chamber being adapted to be thrown open to the sea. In case of a breakdown of the main propeller, the chamber is entered by way of a manhole and the reserve propeller fastened to the old shaft or to a new tail shaft, a piece of the old tail shaft being, if necessary, sawn off to allow fitting the reserve shaft. Then, after removing all the supports of the reserve propeller, the bolts securing the side plates to the plates of the vessel are removed. The chamber is then vacated and the manhole closed up. The temporary retaining means are then loosened and the side plates fall away and may either be allowed to drop into the sea or be hauled on board.